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FARNBOROUGH REPORT

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AP 264/113

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The POWER of Armstrong Siddeley

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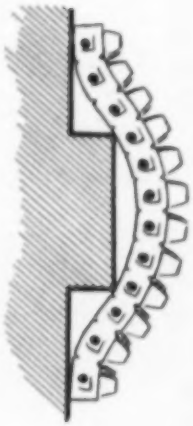

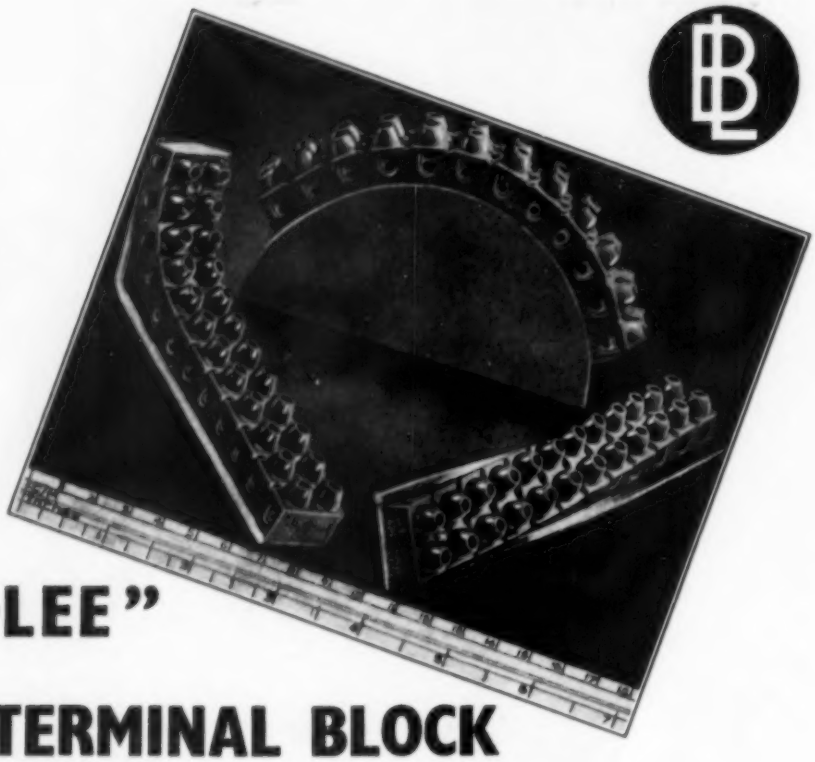

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This unique component was designed to provide great flexibility in both planes, thus enabling it to be secured to curves or irregular surfaces. It is moulded in P.V.C., which securely grips the terminal screws so that they cannot fall out **even if totally unscrewed from their inserts and the block mounted upside down.**

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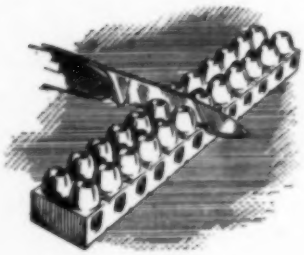
L.744 is a 12-way strip, rated at 5 amp., but may be used at the designer's discretion up to 10 amp., or up to 2kV peak working voltage between terminals or between terminals or chassis. Overall size, 5" x .750" x .625" high. Hole centres spaced .425". L.1325 is a new larger version, rated at 15 amp., and conforms with safety requirements B.S.A.15, at 500v. (r.m.s.).



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for use on D.C. supplies in ***Aircraft, Battery Driven Vehicles,*** *&c.*

The fuse is intended as a direct replacement for the American "Current Limiter" used on 28V d.c. aircraft power supplies, and for this purpose has received the approval of the Air Registration Board under their reference No. E.3217.

It is also suitable for the protection of battery operated vehicles, heavy current rectifier output circuits, low voltage furnaces and other similar d.c. applications.

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RATINGS: 35A, 50A, 80A, 100A, 130A, 150A, 200A, 225A, and 275A. The range will be extended in four further steps to 500A maximum.

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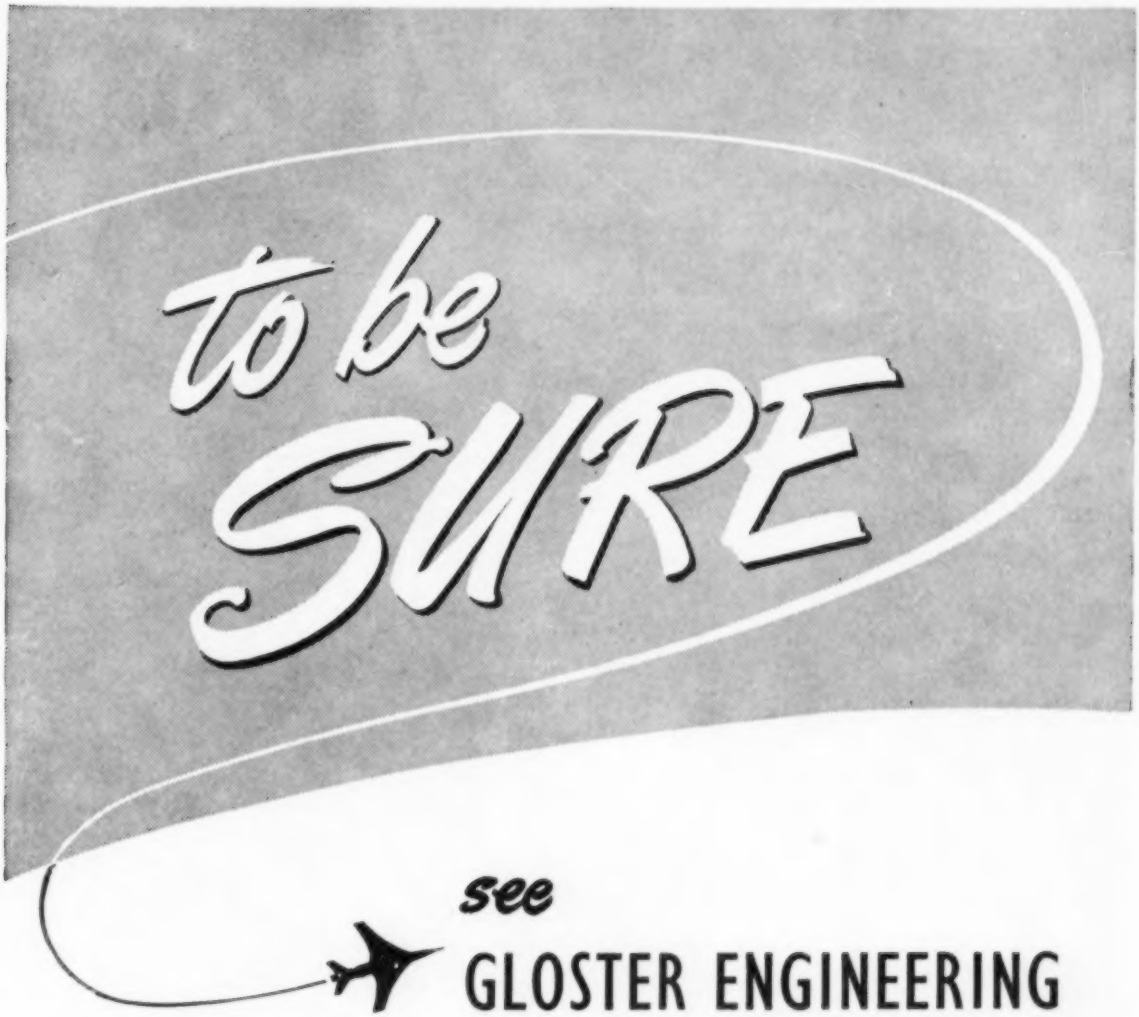

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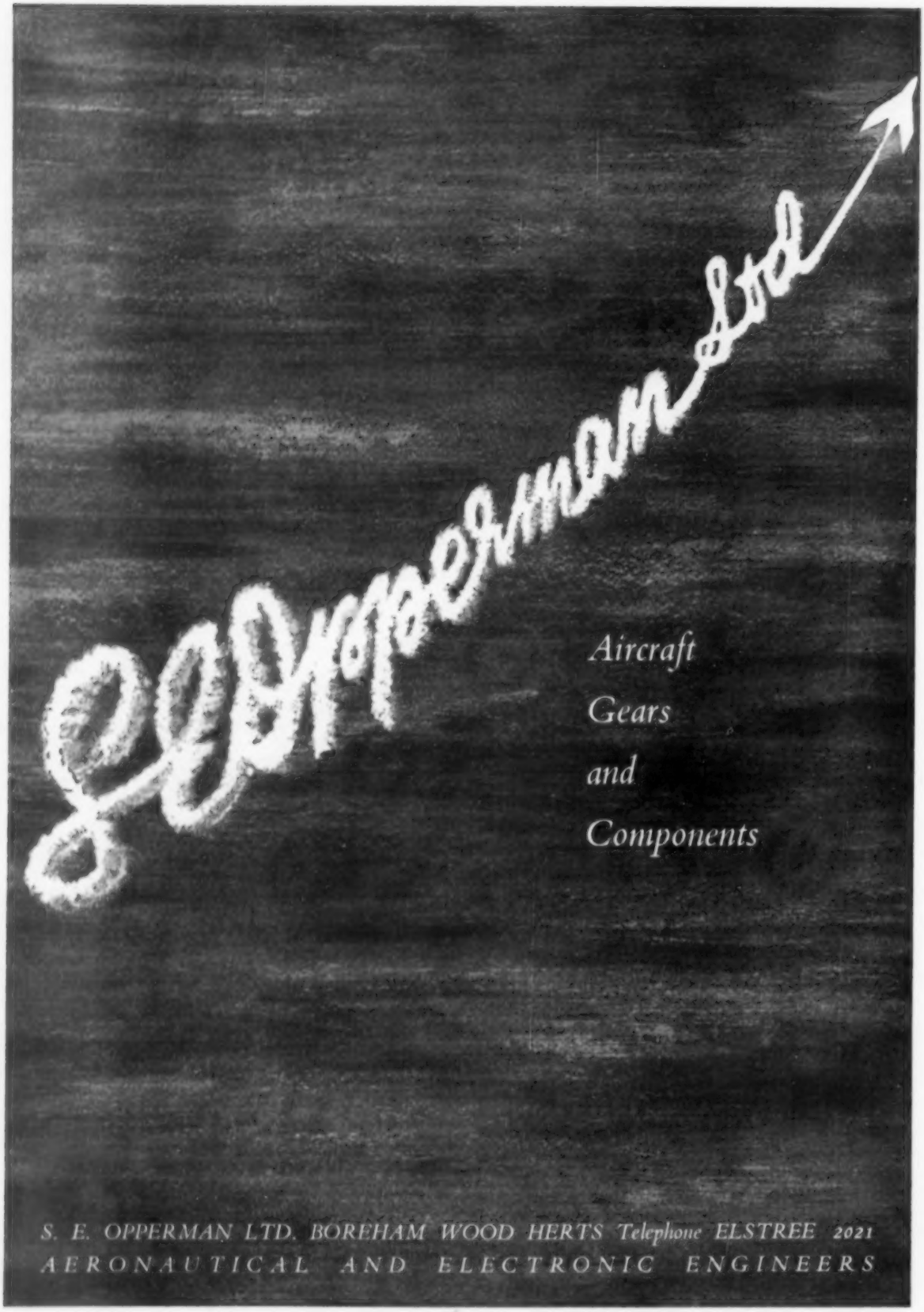
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Transmitter, 2½ watts Output R.T. Adjustable Speech Clipping 0—15 db. Receiver, Double Conversion for 100 Kc/s. Channel Working. Noise Limiter and Adjustable Muting. Size of complete unit 9½" x 7" x 4½" Weight 9lbs. 6oz.

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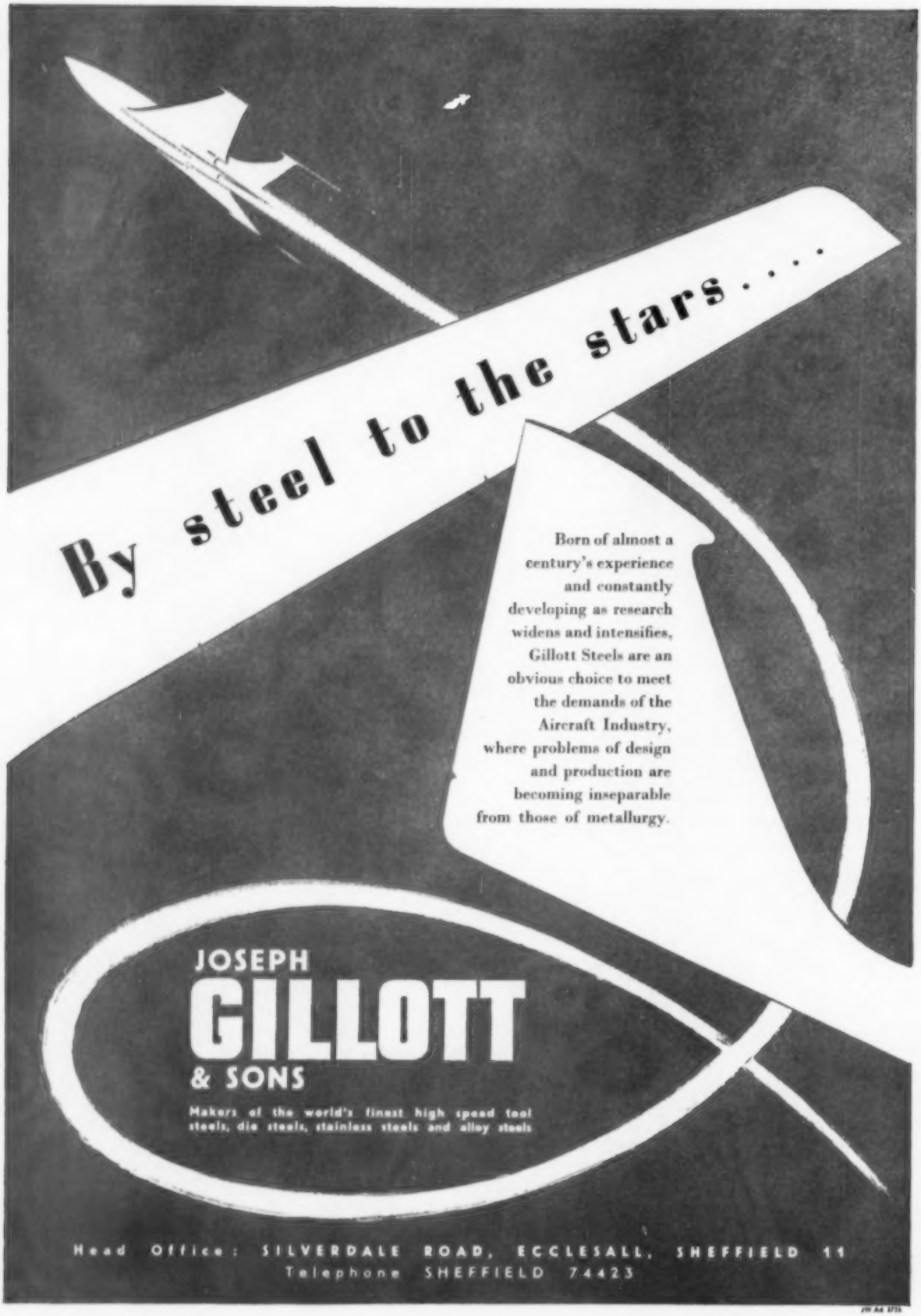
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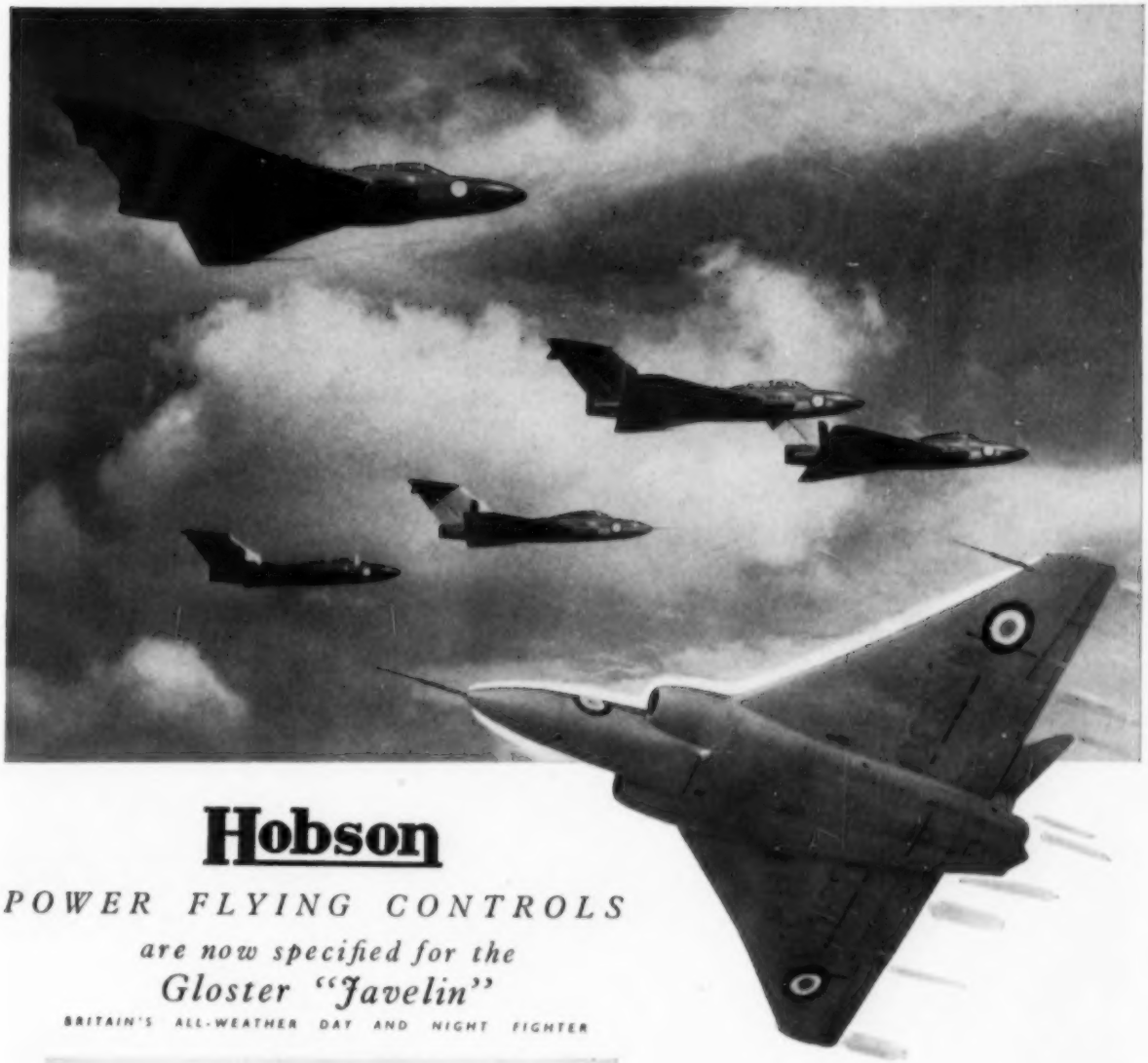


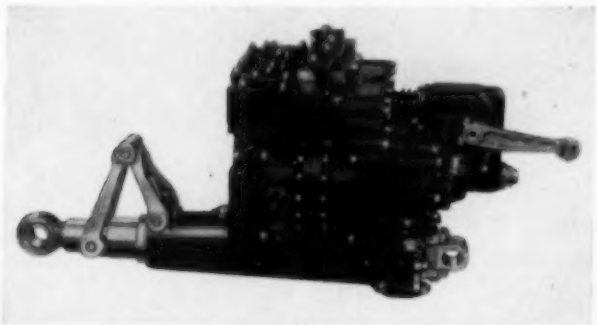
Hobson

POWER FLYING CONTROLS

are now specified for the

Gloster "Javelin"

BRITAIN'S ALL-WEATHER DAY AND NIGHT FIGHTER



Many of Britain's leading aircraft designers are now specifying Hobson Power Flying Controls for operation of the primary control surfaces, including "All-Flying" or "Slab" tailplanes. The duplicated hydraulically operated single screw jack unit, as illustrated, is typical of Hobson units fitted to the Gloster Javelin.

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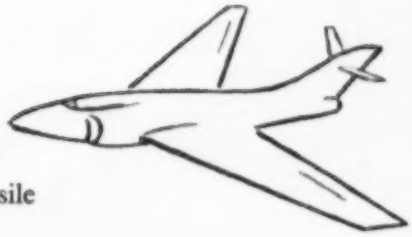

WROUGHT TITANIUM and titanium alloys are being increasingly used in the aircraft industry where their high strength/weight ratio at moderately elevated temperatures can lead to considerable savings in weight over the use of more conventional materials.

Titanium is about half the weight of steel, with a corrosion resistance often superior to stainless steel. By alloying, its tensile strength can be raised to about 70 tons/sq. in.

Manufacture in this country has been pioneered by I.C.I. Metals Division, and the metal is now available in all the usual forms, such as billet, bar, plate, sheet, wire or tube.

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The high strength/weight ratio of aluminium alloys, combined with excellent durability, provides the aeronautical engineer with construction materials of established reliability.

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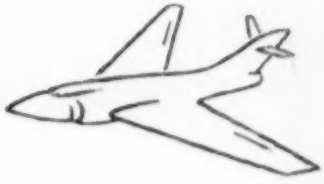

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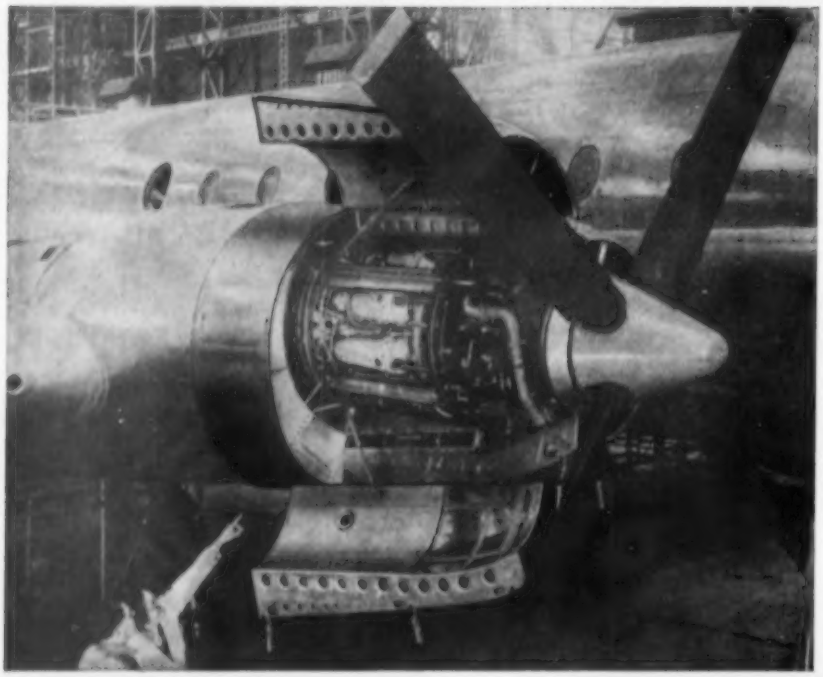

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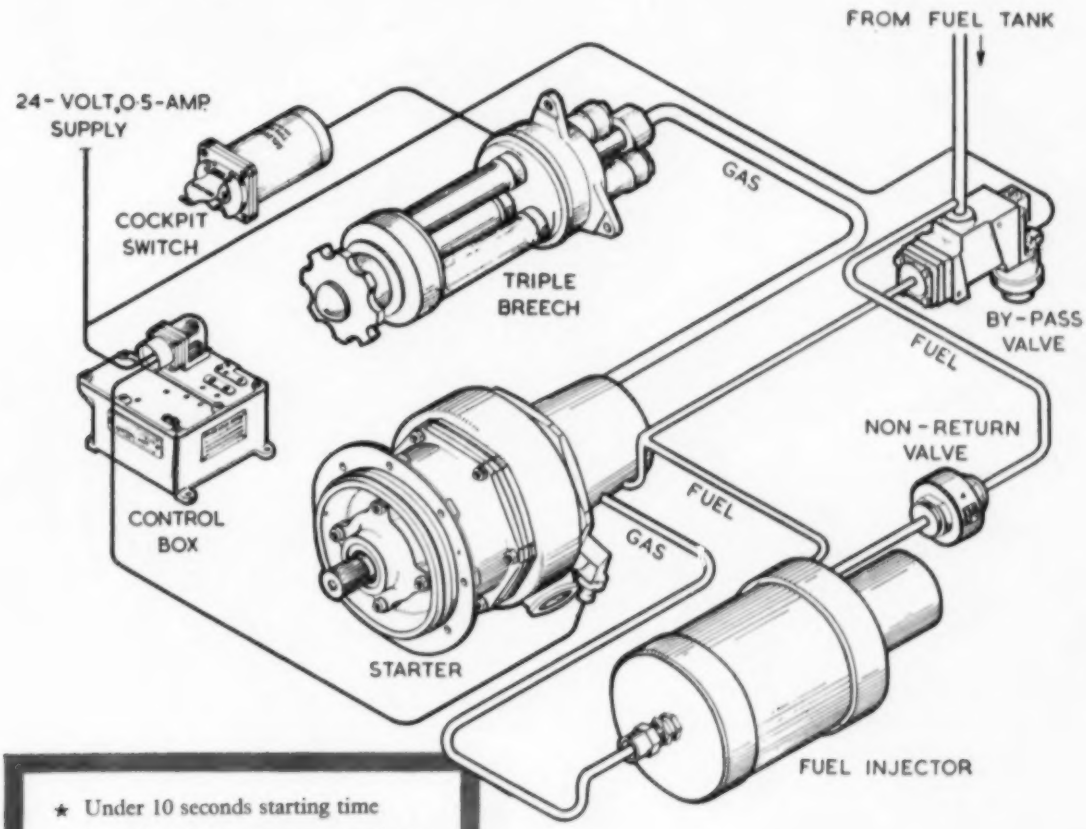

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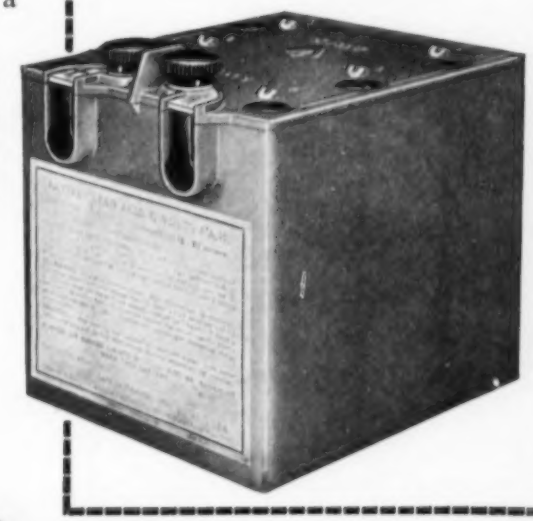

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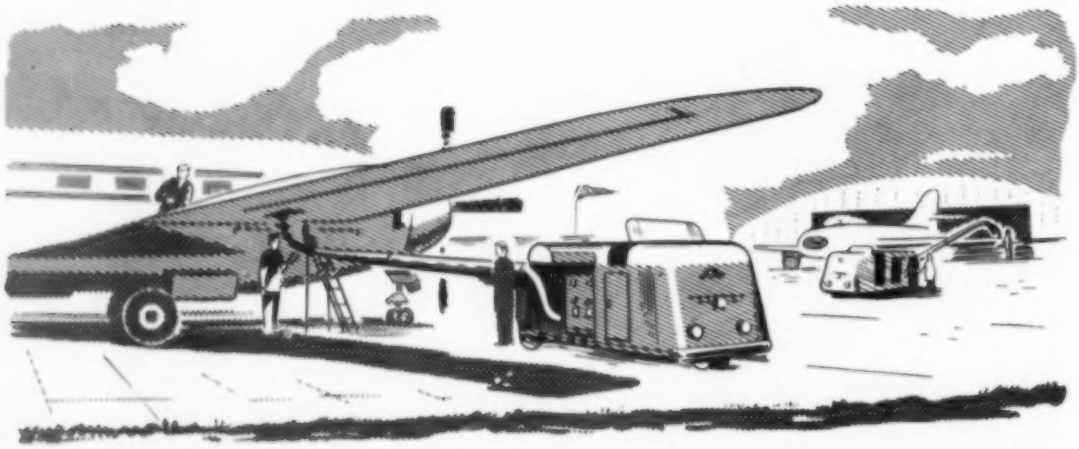

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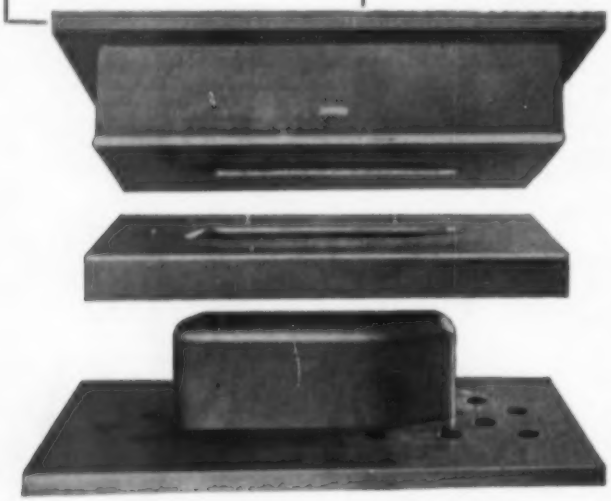
Photograph by courtesy of Weathershields Ltd.



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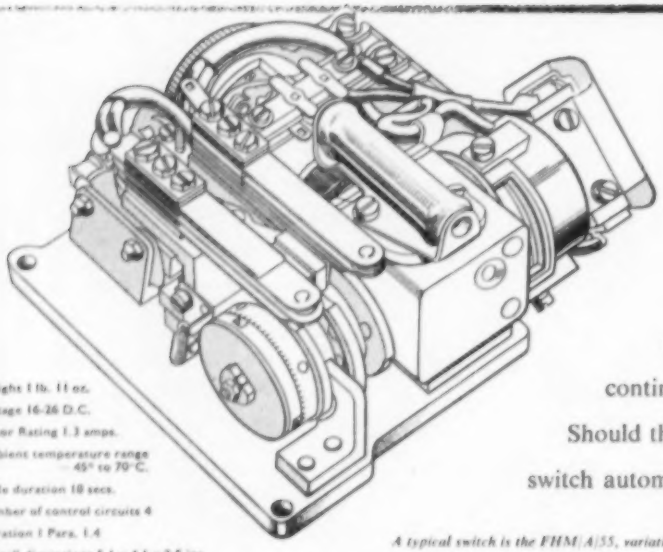

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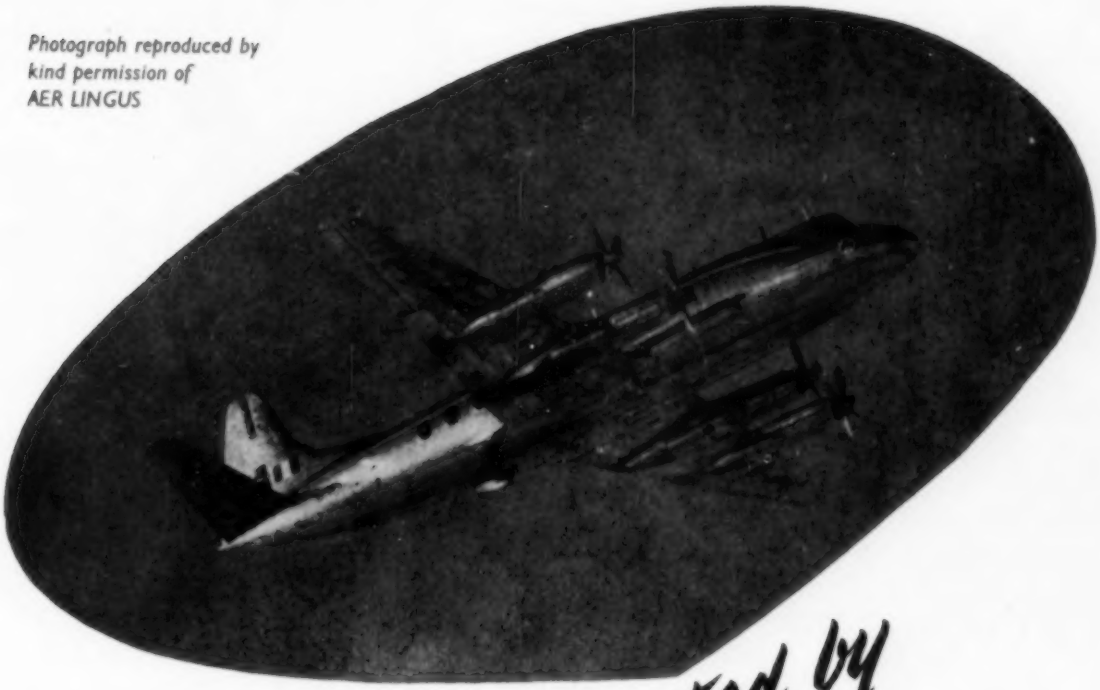

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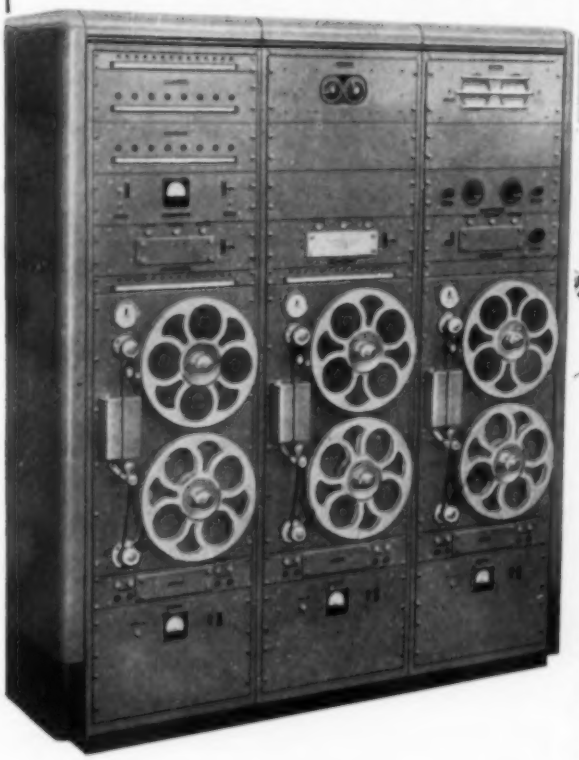

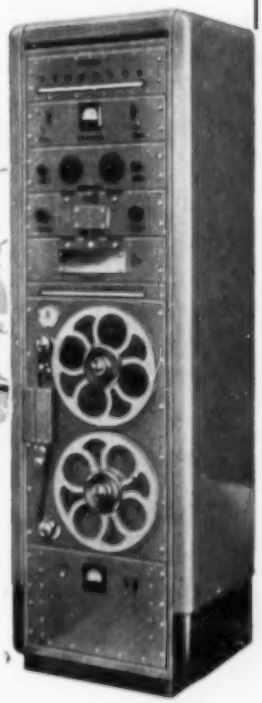

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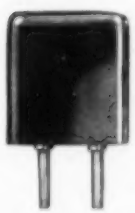

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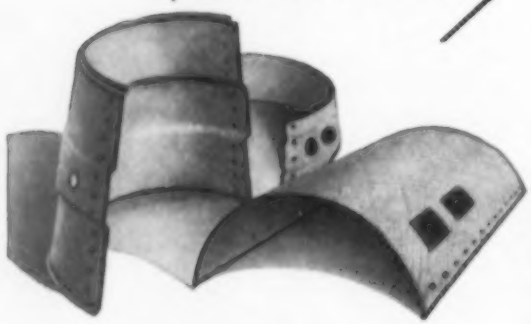

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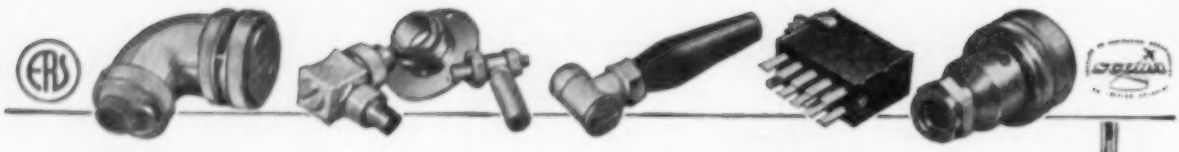

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ASSOCIATE EDITOR
H. F. KING, M.B.E.

TECHNICAL EDITOR
W. T. GUNSTON

ART EDITOR
JOHN YOXALL

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Production—a Change of Method

MISUNDERSTANDING the purpose of the S.B.A.C. Display and Exhibition—which is largely of prototypes—some not-such-good friends of the industry have in recent months sought to give the impression that Great Britain cannot produce in quantity and has taken over from France the title of "prototype builder." Such a suggestion is entirely unjustified for our industry (as, now, it is for the French also). Some small confirmation of this contention is being provided at Farnborough this year when, as an innovation, six squadron pairs of Valiants, followed by a total of 64 Hunters—all from R.A.F. squadrons—fly over.

Before production come specifications and orders. Difficult as it is to predict several years in advance exactly what military aircraft will be required, and when, the attempt has to be made, and a few wrong decisions can be forgiven; indecision, resulting in no orders, cannot. Some orders for the British Services which, it is clear, should have been placed four or five years ago, were not so placed.

While the British firms are well able to build aircraft in series it is still true that the biggest single problem in our industry today is becoming that of production time, and as such, it ought to be tackled more energetically. From prototype to operation takes too long. If we have one major asset, it is design skill and originality; but if someone else, by working more quickly, can have ready at the same time as our product an aircraft based on later knowledge and experience, then our advantage is largely nullified.

There has been ample opportunity to examine American organization, and yet it is still very much the exception over here to find a production staff which enjoys a status equivalent to that of the design side. In our opinion, this is wrong, and it is one reason for uninspired and often dated production methods. Too often in the past companies seem to have contrived rather than planned to meet delivery dates.

Production problems are reaching a climax at a time when methods of construction, particularly of military aircraft, are being radically changed to meet new performance requirements. Is it too much to hope that with the introduction of new materials and methods will come a new approach to production management and practices?

America's Own Show

WHEREAS the Farnborough and Le Bourget displays of the Society of British Aircraft Constructors and the Union Syndicale des Industries Aéronautiques are essentially trade affairs, America's National Aircraft Show, which took place last week-end, is "a report to the nation on the progress of air power" (we quote from the literature addressed to prospective exhibitors). And certainly there is nothing half-hearted about the contribution by the U.S. Department of Defense. At the same time the show is (and again we cite the promotional literature) "the traditional meeting place for those, from all over the nation, who buy and sell the products and services of the industry for private, commercial and military aviation."

The organizing body is Air Foundation, in co-operation with the City of Philadelphia Chamber of Commerce, representing the most concentrated population area of the U.S.A., wherein twenty-one million people live and work within a radius of a hundred miles. The executive committee represents industrial corporations, chambers of commerce and the Armed Services, and customarily the programme includes all manner of diverting and edifying spectacles from clowning helicopters to massed formations of jet bombers. Sometimes there is dramatic evidence of new operational techniques, notably, last year, of FICON (whereby a fighter having atomic capability is air-launched from a B-36). Last year, also, thirty-six Boeing Stratojets flew over non-stop from England.

To such a degree has the show increased in stature and significance that *Flight* this year has arranged to render, next week, a detailed account, illustrated by one of America's most talented air photographers. Service and civil participation was substantially greater than last year. The hangars adjacent to the main show area provided vast under-cover space for the static displays.

A great show, it afforded some striking parallels and contrasts with our own Farnborough week, which opened as the three days of Philadelphia concluded.

FROM ALL QUARTERS

A New Altitude Record—65,876ft

DURING flight-development of the Olympus turbojet, the Engine Division of the Bristol Aeroplane Company have twice found it a comparatively straightforward matter to attack the World altitude record (Class C: aeroplanes). Such is the unbeatable combination of a Canberra airframe and a pair of high-compression turbojets delivering very high thrust up to extreme altitude. Yet it should not be inferred that such records are obtained merely by sitting at the controls, for efficient flying in a regime in which critical Mach number is virtually coincident with stalling speed is not exactly easy. Bristol's assistant chief test pilot, W/C. Walter F. Gibb, D.S.O., D.F.C., was the pilot on both the Olympus-Canberra records.

He took off from the company airfield at Filton at 3.10 p.m. on August 29th and set course on about 290 deg, climbing up to 50,000ft off the Irish coast. He then turned south, to burn off excess fuel during a ten-minute level cruise, at the end of which he again began to climb while heading back to Filton, reaching the peak altitude over the airfield. Power was then shut down, and, taking care to prevent excessive Mach-number build-up, Gibb landed the Canberra at Filton at 4.23 p.m.

The new record figure is 65,876ft (20,079m). This is 3.47 per cent better than the previous record of 63,668ft (19,406m) set up by the same aircraft and pilot on May 3rd, 1953. To set a new record, the previous one must be bettered by three per cent.

English Electric built WD 952, the test-bed Canberra, back in 1951. It is one of the very first production batches of B.2 aircraft, and has since logged a considerable number of hours in several rôles. No aerodynamic changes have been made to the aircraft, and its altitude performance—as an airframe—is inferior to that of the much later P.R. Mk 9.

On its first record climb, in 1953, it was fitted with a pair of Bristol Olympus BOl.1/2B engines, delivering up to 10,000 lb static thrust. Originally, WD 952 was built to take a pair of early Avons, and the installation of the Olympus raised several problems. The big two-spool Bristol engine projected far ahead of the wing, causing c.g., mounting and wing-stressing problems, and the considerably greater mass flow made it difficult to run the new jet-pipe through the spar banjos. These troubles have all been overcome, and the aircraft can now utilize all the thrust available from its power units.

The latter are now Olympus BOl.11s. These are much more recent members of the Olympus family, and their thrust cannot yet be published. It can, however, be stated that they deliver significantly more installed power than WD 952 has ever had before. Overall handling remains outstandingly good, and relights have regularly been made at heights over 50,000ft.

For normal engine-development purposes, the Canberra is equipped with comprehensive instrumentation, including two large auto-observer cameras in the bomb bay. Further equipment is stowed in the space made available by removing one of the two rear ejection seats. For height-record calibration, W/C. Gibb flew alone, a considerable amount of additional recording equipment being carried to provide the most reliable and accurate results.

SATISFACTION ALL ROUND: After the Olympus altitude flight, reported in column 1. Left to right, W/C. W. F. Gibb, Mr. B. G. Markham, Mr. C. F. Uwins, Sir Alec Coryton, and Dr. S. G. Hooker.

Official observer appointed by the Royal Aero Club was, as noted last week, G/C. J. F. H. du Boulay; Philip Mayne was timekeeper. In charge of the instrumentation were Messrs. W. Goldsmith, P. A. Dixon and T. P. Wade, all of the R.A.E. Also from Farnborough was Mr. K. W. Smith, responsible for flight calibration.

Live Ejection at Nought Feet

LAST Saturday evening, at Chalgrove airfield, near Benson, S/L. J. S. Fifield, a Martin-Baker test pilot, carried out the first successful ejection from the back seat of the modified Meteor Mk 7/8, while the aircraft was travelling at 120kt on a grass surface. From the time he pulled the blind to fire the seat to the moment his feet touched the ground in a stable parachute landing, some four or five seconds elapsed.

The seat was a normal Martin-Baker Service Mk 3 seat, with back-type standard parachute and leg-restraint garters. The automatic-release timing mechanism had been modified so that the drogue gun was fired 0.5 sec after ejection and the parachute deployed one second later. S/L. Fifield is an experienced test pilot, but not a professional parachutist. He had made three live ejections before. The pilot of the Meteor was Capt. J. E. D. Scott, the company's chief test pilot.

Though a number of successful dummy ejections from runway level at low speed had been made with both the Mk 3 and Mk 4 seats, this first and completely successful live ejection proves beyond doubt the efficacy of Martin-Baker's latest venture. It provides a new safeguard for pilots of high-speed aircraft.

It is hoped that the release mechanism of standard Service seats will, when the double-drogue deceleration system is fitted, be modified so that either the instantaneous or slightly slower high-speed operations can be available as required by the pilot. Automatic explosive hood jettisoning, initiated by the pulling of the ejection blind, would also be incorporated.

FLIGHT TRIALS of the Curtiss-Wright T49 turboprop began on August 26th, when the Boeing XB-47D took off from Boeing Field, Seattle. Rated at about 6,500 e.s.h.p., the T49 is at present the most powerful shaft-drive aero engine to have flown. It is based on the J65 Sapphire turbojet, and is derated in B.E.25 manner. The XB-47D is a converted B-47B, the T49s replacing the two pairs of inner General Electric J47 turbojets.

Valiants to the Far East

COINCIDENT with the visit of Air Marshal Sir George Mills, A.O.C-in-C. Bomber Command, to Australia this week, two Valiants of No. 138 Sqn. were to leave their base at Wittering to fly to Singapore for a month of proving trials. In command of the aircraft are S/L. R. G. Wilson and F/L. R. Mather and the route to Singapore was *via* Habbaniyah (Iraq), Karachi (Pakistan), and Negombo (Ceylon). Preliminary arrangements are also in hand for an extension of the flights to include Australia and New Zealand.

Air Marshal Sir George Mills is himself attending the Air Force Commemoration Week ceremonies in Australia and is later to visit New Zealand at the invitation of the New Zealand Government. He is flying out in one of the four Hastings carrying ground crew and equipment for the Valiants. No. 138 Sqn. is commanded by W/C. R. G. W. Oakley.

Peter Masefield Joins Bristol

AN important reorganization of the Bristol Aeroplane Co., Ltd., was foreshadowed in an announcement last Monday. With it came the news that Mr. Peter Masefield has resigned from the post of chief executive of B.E.A. in order to become the first managing director of one of the new Bristol companies.

Under the new arrangement, the work of the present three main divisions of the company will be undertaken by three new subsidiary companies, to be known respectively as Bristol Aircraft, Ltd., Bristol Aero-Engines, Ltd., and Bristol Cars, Ltd. They will take over the assets and liabilities of the existing divisions on January 1st next.

Mr. Masefield.

The following are being appointed first directors of the new companies:—

Bristol Aircraft, Ltd. — Sir Reginald Verdon Smith, C. F. Uwins (chairman), Brian Davidson, A. Cdre. F. R. Banks, Dr. A. E. Russell, R. S. Brown, W. R. Farnes, H. J. Pollard.

Bristol Aero-Engines, Ltd.—Sir Reginald Verdon Smith, Air Chief Marshal Sir Alec Coryton (chairman), Brian Davidson, A. Cdre. F. R. Banks, Dr. S. G. Hooker, George Hack, John Innes, R. L. Ninnes, Dr. E. Warlow Davies.

Bristol Cars, Ltd. — George White (chairman), Brian Davidson, William Masterton.

"In the case of the Bristol Aircraft, Ltd.," says the company ". . . by agreement with British European Airways Corporation and with the approval of the Minister of Transport and Civil Aviation, Mr. P. G. Masefield, Chief Executive of British European Airways Corporation, has accepted an invitation to become the first managing director. He will join the Bristol Aeroplane Company, Ltd., in November and will take up his directorship of Bristol Aircraft, Ltd., on the 1st January, 1956."

In a letter to the Minister of Transport and Civil Aviation Mr. Masefield has said that he feels that his "duties towards British aviation lie more clearly in making what contribution I can in the direction of the more pressing problems of British aircraft development and production." He emphasizes that his resignation is not the result of any differences of view on policy, and Mr. Boyd-Carpenter has accepted his resignation "with very deep regret," also mentioning his admiration for the "grand job" Mr. Masefield has done for B.E.A.

Still only 41 years of age, Peter Masefield has had a remarkable career in aviation, beginning in 1935 when he left Cambridge in order to join the Fairey design staff. Two years later he became a member of the staff of *The Aeroplane* and in 1939 was appointed its technical editor. He went to France in 1939 with the Advanced Air Striking Force; and later, as a war correspondent, he flew with the R.A.F. and the U.S.A.A.F., qualifying with the latter as both co-pilot and air gunner on B-17s. In 1943 he was personal adviser on civil aviation to Lord Beaverbrook, who was then Lord Privy Seal; and he also was secretary of the War Cabinet Committee on Postwar Civil Air Transport. In 1945 he was appointed British Civil Air Attaché in Washington and a year later returned to this country to fill the post of Director General of Long Term Planning and Projects at the M.C.A. Afterwards he became in quick succession assistant to B.E.A.'s chairman, then deputy chief executive, then chief executive.

He is a vice-president and member of the Council of the R.Ae.S., and is president-elect of the Institute of Transport and president of the Popular Flying Association and of the Aircraft Recognition Society.

New British Engines

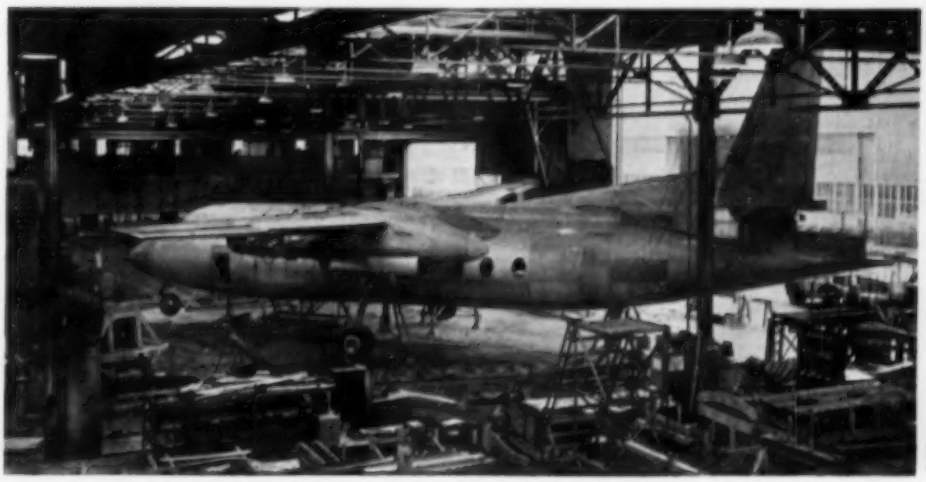
LAST Friday, September 2nd, two new British powerplant designations were cleared for publication. The Gyron Junior DGJ.1 is announced as a new turbojet manufactured by the de Havilland Engine Co., Ltd. The Sapphire ASSa.8 is likewise announced as a new Sapphire variant by Armstrong-Siddeley Motors, Ltd. Type-tested ratings are also announced for the de Havilland Gyron DGy.1 at 15,000 lb thrust and the A-S Viper ASV.8 (up-rated ASV.5) at 1,750 lb thrust.

In announcing the Gyron Junior, the de Havilland Engine Company described it as smaller than the Gyron (as one might expect) and referred to the possibility of a family of Gyron engines. The Gyron Junior was recently run on the test-bed for the first time, after an exceedingly rapid period of initial development under a Ministry of Supply contract.

On pages 449 to 452 of this issue will be found an account of the characteristics and background of development of the three engines which are being shown at Farnborough this year for the first time. They are the de Havilland Gyron turbojet, the Rolls-Royce Conway by-pass turbojet and the Napier E.151 Eland powerplant for the Fairey Rotodyne helicopter.

Incidentally, it is not generally known that the Avon turbojets installed in the Canberra P.R.7 which recently flew to New York and back in 14 hr 21 min were manufactured at the Netherton (Liverpool) factory of D. Napier and Son, Ltd. At this plant, Napier are already starting production of the Eland (fixed-wing) turboprop, and commercial deliveries are expected next year. Avon production is tapering off thus releasing progressively more floor space for the manufacture of Napier's own engines.

Napiers were also responsible for the installation of the Rolls-Royce Conway by-pass turbojet under the belly of the Ministry of Supply's Avro Ashton test-bed. The work was done for the National Gas Turbine Establishment by the Napier Flight Development Establishment at Luton. The first flight with the Conway installed was made from Luton late last month, the aircraft being jointly flown by Mr. Mike Randrup and Mr. A. J. Heyworth, respectively chief test pilots of Napier and Rolls-Royce.



***BLOSSOMING FRIENDSHIP:** The trim lines promised by artists' impressions are realized in this view of the first prototype Fokker F.27 Friendship in its assembly hall at Schiphol. The two Rolls-Royce Darts have been installed and the airframe shell is virtually complete, though the first flight, apparently, is still some weeks away.*

FROM ALL QUARTERS . . .

Proteus Icing Trials

THE Engine Division of the Bristol Aeroplane Company have been carrying out extended trials of the Proteus turboprop with an Ambassador test-bed, and we can now present photographs showing a particular series of icing trials in which airborne television has been used to good effect. The whole programme was conducted in connection with the Britannia C. of A., and showed the Proteus to be completely immune from icing.

In order to obviate protracted searches for icing conditions, artificial icing was induced by a water-sprayed grid mounted in front of the port engine, as shown in one of the photographs. Water was supplied from a 135-gal tank in the rear of the aircraft and pumped to the grid, whence it issued from 37 nozzles directed at the spinner and intake. Details of the Proteus ice protection were given in our Britannia description on August 12th. Hot gas is extracted from the turbine section and passed around the critical parts of the cowling and intake casing, and electric heating mats (Napier "Spraymats") are used on the fixed external portions of the cowling. A hot-air bleed from the starboard engine was carried round to provide ice protection for the spray grid itself.

The maximum flow from the grid was about 500 lb per hour. Before actual testing began, the effect of the spraying installation on the behaviour of the aircraft was examined, both in normal flight and with one engine inoperative, and the drag was found to be negligible. Another pre-series of tests was conducted with dye-impregnated water to ensure that the droplets were finding their way into and around the engine. It was naturally desired to obtain a pictorial record of ice formation on the interior of the engine. Had a normal ciné camera been employed, the programme would have resolved itself into a tedious step-by-step analysis occupying many months, the film recording each stage of the tests having to be processed and examined before proceeding further. By employing TV the whole programme was completed in 20 hours of flying—roughly a tenth of the amount which would otherwise have been needed.

A small fan-cooled Pye camera was flexibly mounted inside the port Proteus and focused on the compressor entry guide vanes. It is a remarkable fact that the entire programme was completed without the cathode ray tube of the camera having to be replaced—a testimony to the vibration-free environment and to the durability of the camera. Pictures were relayed to a 14in screen inside the aircraft. It is also worth noting that the camera signal could have been broadcast to the ground below, so that the division's chief engineer, Dr. S. G. Hooker, could have watched the ice formation from the comfort of his office.

Inside the Ambassador the flight test crew were able to obtain a clear picture of the actual build-up of ice at the compressor entry. With the anti-icing inoperative, the camera revealed deposits building up in various forms, the accumulation sometimes forming pieces $\frac{1}{4}$in wide and $3\frac{1}{2}$in long. At intervals the deposits would break off and pass through the engine. Years ago this would have been likely to cause damage to the Proteus, but the substitution of steel for light-alloy blades throughout the compressor has rendered the passage of even steel bolts relatively harmless.

PROTEUS DE-ICING TESTS (see col. 1): Taken after ice had been forming for 30 minutes (with de-icing switched off), this photograph gives a good idea of the type of icing which could be engendered. Energizing the de-icing removed such deposits in a few seconds.

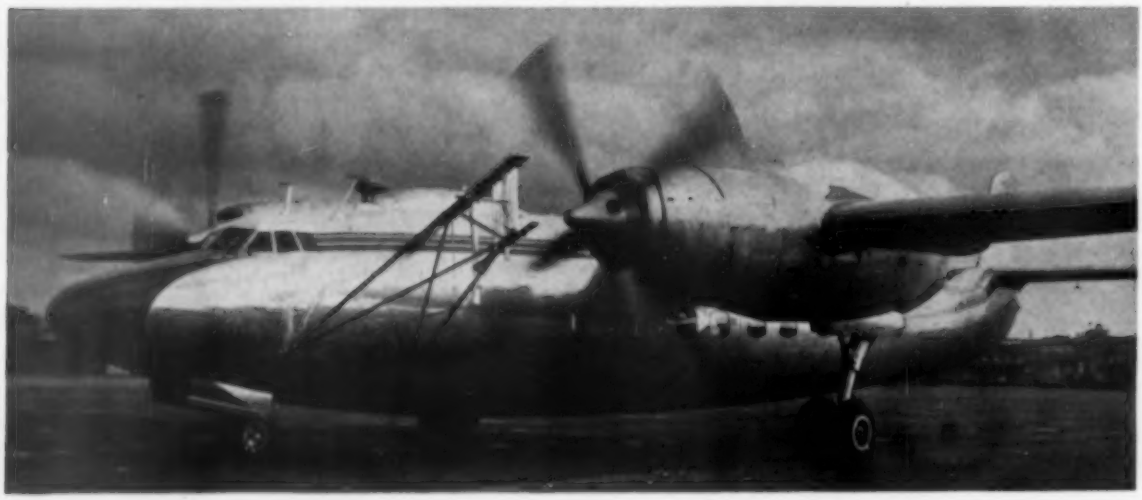
At no time did the behaviour of the Proteus give the slightest cause for anxiety and the engine was accelerated and decelerated satisfactorily under these conditions. In the most severe cases, with the anti-icing switched off, ice accretion on the entry guide vanes caused a loss of only 3 per cent power after about 17 min, and the severest deposits were always disposed of a few seconds after the de-icing was switched on. Flying took place at from 10,000 to 30,000ft and temperatures as low as minus 44 deg C were encountered. Testing was carried out at various airspeeds and with the port engine at all powers, including maximum compressor r.p.m. and zero r.p.m. with the airscrew feathered.

Further anti-icing trials are now being carried out with another Proteus powerplant embodying a number of production refinements. In particular, the latter engine can utilize a greater supply of heat for affording ice protection in the region of the entry guide vanes.

Blackburn Interest in Jowett Factory

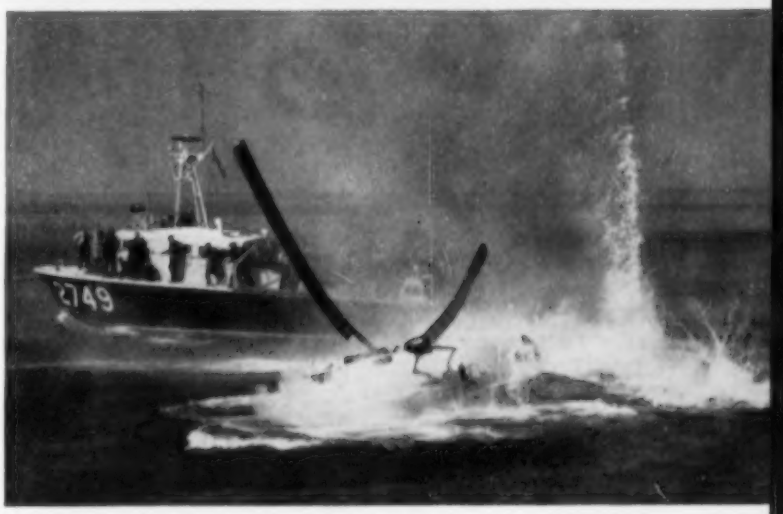
IT is learned that Blackburn and General Aircraft, Ltd., are expected next week to make a firm offer to acquire the whole of the issued share capital of Jowett Cars, Ltd., of Batley, Yorkshire, at 3s 3d a share. The Jowett directors have notified Blackburns of their present view that they will accept the offer for their own shares, and will recommend shareholders to do the same. Jowett Cars, Ltd., was founded 30 years ago, but are not now in production. Presumably, Blackburns' interest is to acquire additional manufacturing capacity in the Yorkshire area.

ICE TO ORDER: Taxying out at Filton, the M.o.S. Ambassador (second prototype G-ANRD) displays its water spray rig (see news story above). The engines are at present Proteus 705s, similar to those used in the Britannia 100.



ROTOR-BORNE LIFEBOATS

Helicopters for Search and Rescue: an Accident while Demonstrating



Two remarkable photographs of the accident described on this page by "Flight" representative aboard launch 2749. In the upper picture, the tail boom is just beginning to break under the down-loads of the impact.

ONE of the first of a chain of helicopter units being established by the Air Ministry for search and rescue duties throughout the British Isles is No. 22 Squadron of Coastal Command, equipped with Westland Whirlwind HAR.2 machines and based at Thorney Island. A press demonstration of the squadron's work, given in the English Channel last week, was marred by an accident to one of the Whirlwinds, which suffered engine failure, ditched in the sea, and sank. There was no injury to either occupant of the aircraft.

Flight's representative aboard an accompanying R.A.F. launch gives the following account of the squadron's operations and eye-witness report of the accident.

Formed in February of this year, No. 22 Squadron is the second R.A.F. helicopter squadron engaged on search and rescue duties, the first being No. 275, a Fighter Command unit based at Thornaby, County Durham, and operating Bristol Sycamore Mk 14s. From Thorney Island, the Whirlwinds have as their main task the rescue of aircrew in difficulties (either ashore or afloat); in addition, much rescue work has been carried out this summer for civilian holiday-makers.

Commanded by S/L. Paul C. Bowry, 22 Squadron has a unit at Martlesham Heath, Suffolk, in addition to the main section at Thorney Island where crew training and periodic servicing of both airframes and P. and W. Wasp R-1340 engines are carried out. In the near future, a third unit will be stationed at Valley, Anglesey. The squadron's helicopters, together with R.A.F. marine launches and other units, are controlled in emergency operations by the R.A.F. Rescue Co-ordination Centre at Plymouth, and at least one machine at each base is at readiness from dawn to dusk each day.

The demonstrations of search and rescue techniques made by 22 Squadron and other units on August 30th took place in the English Channel, some 8 miles south of Selsey Bill, in warm summer weather and with a calm sea. A typical example of rescue co-ordination was first given, in which a Coastal Command Shackleton II flew over, spotted a dinghy containing five men, and reported this by radio to the Rescue Co-ordination Centre at Plymouth.

The normal rescue procedure followed. A "flash" (top priority) telephone message was sent from Plymouth to Thorney Island, calling for the assistance of the standby Whirlwind. Also available and controlled from Plymouth in such emergencies are R.N. and R.A.F. marine craft, civilian lifeboats, and other services; on this occasion, the presence of two 68ft launches and a smaller tender only a few yards away from the dinghy in distress was, for purposes of plot, tactfully ignored.

Having informed Plymouth, the Shackleton dropped a smoke marker near the dinghy, and continued to circle around it. After a short delay, a bright airborne lemon appeared in the distance and, approaching, rapidly turned into Whirlwind XJ 434, flown by F/L. Keith V. Panter, D.S.O. The helicopter's colour scheme was a gaudy yellow, with RESCUE in black on the tail-boom fairing. Hovering above the dinghy, it proceeded to dip into it with what looked like a hangman's noose, and to lift and swallow each of the occupants in turn.

The double-lift method, in which a crewman is lowered to affix the strop around an injured or unconscious man, and both are then winched up together, was also shown. An immersion-suited B.B.C. man, suitably immersed, was the victim.

The rescue techniques shown so far had been equally applicable to both Service and civilian emergencies. A development of particular significance in the case of ditched aircraft crews—the use of Ultra Electric's SARAH (Search and Rescue and Homing) equipment—was next demonstrated.

Another of the squadron's Whirlwinds, XJ 436, flown by S/L. Bowry, was homed from its base at Thorney Island on to a pilot who, complete with SARAH beacon, was adrift in a one-man dinghy.

The signal-transmission radius of the SARAH beacon is stated to be 75 miles, and the current equipment incorporates two-way voice communication. The system is felt to be particularly valuable in that, once the beacon is switched on, continuous transmission and individual identification are provided; and no dependence is placed on visual search. Receivers can be carried by aeroplanes, helicopters and marine craft.

The Navy-developed scoop net, which forms another part of the equipment of 22 Squadron, was next used by XJ 436 to capture—at the third attempt—yet another floating victim.

The final demonstration was to be the winching up, from the deck of our launch, of an *Evening News* reporter securely trussed in a Neil Robertson stretcher. After hovering over the launch, S/L. Bowry flew the Whirlwind to one side while final preparations were made on deck. Coming round and in again between our launch and another some 50 yd away, the helicopter was moving slowly forward at a height of about 30ft when its engine spluttered and cut, and the machine fell into the water.

In a mist of sudden spray, the Whirlwind tilted over on its starboard side, its rotors thrashing the surface. A crack tore across the word "RESCUE," and the tail boom twisted jerkily. In slow, lurching movements the machine sank over on its side, and we were relieved to see that pilot and navigator (Flt. Sgt. Grant Scoggins) had managed to escape from cockpit and cabin respectively and, with Mae Wests inflated, were floating alongside.

Within two minutes of the initial power failure, the two men had been picked up by the attendant tender; one minute later the machine had disappeared, leaving only small yellow fragments powdering the surface of the Channel.

From a distance of about 30ft, we had had an uncomfortably close view of the accident. While it provided an extremely unfortunate finale to the day's demonstrations, it served as a reminder that engines are still liable to occasional failure (at the most awkward times); and that, perhaps, B.E.A. were not to be blamed for excessive caution in fitting floats for passenger-carrying services over the Thames.

K.T.O.

OUT IN A HURRY: S/L Fifield, whose successful live ejection at ground level is described in a news item on p. 430, is seen at the top of the trajectory, as his parachute opened and the seat left him. Above, none the worse for wear, he is congratulated by the technician who retrieved his parachute after the landing. "Flight" photographs

HERE AND THERE

Czechoslovak Jet Bombers

TWIN-JET bombers—said by Western observers to resemble the Soviet Il-28—were seen for the first time at an air display at Prague last week-end. Also demonstrated was Czechoslovakia's first helicopter, a light machine with an 80 h.p. engine.

Doret's Death Reported

IT was reported in Paris last week that Marcel Doret, the veteran French test and aerobatic pilot, had died in Toulouse on August 31st at the age of 59.

B-47s' Trans-continental Race

A RACE across the United States by three B-47s for a trophy given by General Electric was won by Major J. L. Stevens at an average speed of 589.294 m.p.h. for the 2,337-mile flight.

The Quick Way Out

IN 1954, exports by air from the United Kingdom totalled £60,400,000 in value, according to the *Board of Trade Journal*. This figure is an increase of over £5m in comparison with that for 1953.

I.A.L. in the Antarctic

THE firm of International Aeradio, Ltd., have been appointed consultants on communications to the Antarctic Aerial Survey Expedition to the Grahamland Peninsular which is being undertaken by Hunting Aerosurveys, Ltd., under the auspices of the Colonial Office, for the Falkland Islands Dependencies. Besides advising on the equipment required for the expedition, for use on the survey vessel, the amphibian aircraft, helicopter and the base station at Deception Island, I.A.L. are providing staff to install and maintain it.

Swiss Prototype Destroyed

THE new Swiss P-16 jet fighter was destroyed last week after being in trouble at nearly 40,000ft. The pilot baled out safely; the aircraft fell into Lake Constance, whence it was hoped to recover the wreckage for examination.

T.V. Film Exported

THE B.B.C.'s television film series *War in the Air* has been sold for distribution throughout the United States on television. This is the first time a B.B.C. film has been sold in the U.S.A.

Helicopter Safari

THREE Americans, James Patterson of the Sikorsky Division of United Aircraft, Karl Jensen of the Lederle Laboratories, and H. Davis, a writer, are in Leopoldville, Belgian Congo. They are about to begin a helicopter expedition across Central Africa.

Frank S. Cotton

THE death is reported in Sydney of Frank S. Cotton, O.B.E., A.R.Ae.S., the inventor of the "Sidcot" flying suit, "teardrop" windows for aircraft, and other devices. He was also co-patentee with A. Cdre. Helmore of the Turbinlite and Leigh light. Born in Australia in 1894, he served with the R.N.A.S. in World War I.

For Winter Evenings

NEXT Wednesday, September 14th, our associated journal, *Amateur Photographer*, is publishing a special "Indoor Number" in which enlargers, projectors, flash outfits and other equipment will be reviewed.

Licensed De-icers

AN agreement for the manufacture and sale of the Napier "Spraymat" electrical de-icing in the United States has been signed between D. Napier and Son, Ltd., and Power Generators, Inc., Trenton, New Jersey. The system has recently been tested under U.S.A.F. auspices.

Armstrong-Siddeley Appointments

TWO Armstrong-Siddeley appointments announced last week-end, and of which we hope to give further details next week, concern two ex-R.A.F. officers. One is A. Cdre. H. M. ("Toby") Pearson, who is joining the company for liaison duties; the other is F/L. T. P. Frost, who has joined as chief test pilot.

City Livery Company's Officers

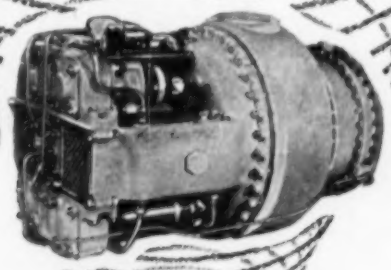
THE Court of the Worshipful Company of Coachmakers and Coach Harness Makers has elected the following officers for the ensuing year: Master G/C. F. C. V. Laws; Senior Warden, Col. Rt. Hon. Lord Kenilworth; Renter Warden, Lt.-Col. R. D. Thrupp; Junior Warden, Mr. R. J. D. Smith.

AN HISTORIC AIRCRAFT—"The Spirit of St. Louis" in which Charles Lindbergh flew the Atlantic in 1927—has been reconstructed, as shown here, for a Warner Brothers' film now being completed. Lindbergh's arrival at Le Bourget was re-staged last week at Guyancourt, near Versailles, where this photograph was taken. We hope shortly to publish a further note on this unusual cinematographic enterprise.

THE "PALOUSTE"

SUPPLIES POWER FOR THE

FAIREY LIGHT HELICOPTER



Blackburn and General Aircraft Limited.

ENGINE DIVISION

43 BERKELEY SQUARE, LONDON, W.1

LONDON - NEW YORK - LONDON

That's Shell-that was!

An "English Electric" Canberra P.R. 7 has just set up a new two-way transatlantic flight record. This aircraft was crewed by Mr. John Hackett, and Mr. Peter Moneypenny of Silver City Airways, using Shell Aviation Turbine Fuel.

SHELL-MEX AND B.P. LTD

DISTRIBUTORS IN THE UNITED KINGDOM FOR THE SHELL, BP AND EAGLE GROUPS

THE OPENING OF THE SHOW

Farnborough, September 5th

THE sombre rainclouds which overshadow Farnborough on this of all Monday mornings cannot obscure the fact that the 16th S.B.A.C. Flying Display and Exhibition is the largest and most promising ever. The 1955 show is bigger than last year's both in the number of overseas guests (6,000 personally invited and others using bulk-allocated tickets) and in the size of the static exhibition, with its 307 stands. Forty-one aircraft are taking part in the flying display and the static display brings the total number of machines exhibited to nearly 60. Of these, 16 are making their maiden appearance at Farnborough. In addition, R.A.F. formations are participating for the first time, though the S.B.A.C. emphasize that the Service contribution—essentially, a show of Valiant and Hunter strength—does not change the basic purpose or pattern of the show, which is designed to sell aircraft and equipment.

Yesterday morning saw *Flight's* editorial advance-guard making their preliminary circuit of the sprawling show-site, while L. W. McLaren, overhead in the R.A.E. Packet, registered photographic impressions of the arriving aircraft—with the results seen on following pages. By Sunday evening almost every machine had been tethered in its assigned place on the runway, and in the static tent all seemed ready for the morrow. The near-deserted appearance of the indoor display was in sharp contrast to the scene on previous eves-of-Show, requiring near-miracles of constructive effort to complete the stands on time.

As with the static exhibits, so it has been this year with the aircraft. Both of the brand-new transport prototypes—Herald and Twin Pioneer—flew well in advance of the show and are complete in every furnishing detail. Their external appearance, at once attractive and functional, is calculated to appeal to the airline customer. Among the giants, the outstanding splash of colour is provided by the cerulean-blue Victor, its fellow V-bombers appearing in dull-silver Service uniform. The Britannia 100 and Comet 3 are here again in dignified B.O.A.C. styling, and the Beverley—fifth off an accelerating production line—displays current Transport Command dress, with white cabin-top. Looking potent and businesslike in smoky grey, the Shackleton appears in latest Mk 3 form, with nosewheel, tiptanks and other mod. con.

Weather apart, the only disappointment experienced by Monday's pre-viewers was the absence until 6 p.m., when many had already left, of the supersonic P.1. It parked at Odiham to make its debut on Tuesday. Other members of the high-Mach brigade, however, afford ample consolation. Fairey's needle-nosed Delta 2 demonstrates an astonishing turn of high-speed manœuvrability, and the F.R.5 Swift performs nobly in its new low-altitude role. The side-by-side Hunter, seemingly no less fleet than its predecessors, is perhaps the most effective dual conversion yet achieved.

Helicopter-wise, as our American guests would have it, the 1955 Show is the best yet. Progress in the application of new propulsive systems is shown by two newcomers, Fairey's "ultra-light" and Jet Gyrodyne, and the Widgeon, aimed at today's market, represents a handsome variation on an existing theme. Notes on the various aircraft follow.

Like some strange pecking bird, the Fairey F.D.2, nose depressed and 'chutes streaming, comes in to land at Farnborough. The general view above was taken from a Westland air taxi which had collected visitors from London's South Bank Heliport.

"Flight" photographs

THE OPENING OF THE SHOW . . .

Armstrong Whitworth A.W. 167. This designation has been applied to an interesting new design-study for a jet transport, shown in model form. The Caravelle-like fuselage has a quintet of tail-mounted Sapphires, breathing through an annular intake. Capacity would presumably be for at least 100 passengers. All surfaces are swept, the wing being of low aspect ratio and low-mounted. The tailplane is set on the fin.

Auster A.O.P.9. Camouflaged, and serialled WZ 715, the A.O.P. is resting in the static park on the public days, having displayed its in-flight capabilities during the week. The example shown this year is a standard production version, as now in full squadron service. Notable features of this rugged Army three-seater are the drooping ailerons and removable cockpit floor, which can be unbolted in one piece and replaced by an alternative installation within 20 min.

Auster Aiglet Trainer. G-ANXC, the Aiglet to be demonstrated by Ranald Porteous at the week-end, is a fully aerobatic four-seater of latest production type. The cockpit has been widened for increased comfort on long cross-country flights.

Auster Autocar. A complete Autocar fuselage is the centre-piece of Auster's indoor stand. The designation Autocar 145 denotes the installation of a 145 h.p. Gipsy Major as an alternative to the previously standard 130 h.p. unit.

Aviation Traders Accountant. Dominating the outdoor annexe to the static exhibition is a complete, superbly finished Accountant rear fuselage. The exterior is polished and white-topped (by courtesy of Cellon), but cabin insulation and interior trim have been omitted so that guests may study the Heal method of tensioned-skin construction. Ten "petal" panels are the major fuselage components. At Southend, where the first Accountant should fly in the early summer of 1956, the same system has been applied to tailplane construction, with promising results. The design incorporates provision for a swinging nose, providing loading through the full width of the fuselage; a survey of operators, however, shows that only ten per cent require this feature, and the prototype will have a "fixed" nose.

Avro Vulcan. The machine chosen for display at this year's show is XA 890, the second pre-production Vulcan. In most respects the machines of this batch resemble the first type of standard production Vulcan, and full operational gear is installed. The most noticeable external evidence of the latter is the revised nose, with its enormous dielectric covering over the most expensive and advanced radar bombsight ever carried by a British aircraft. On the outside of the nose is stencilled the instruction "safety catches not to be released until all personnel are out of the radome," and a grille outlet for cooling air can be seen on the port side. Under the nose is the optical sighting station, with a single flat transparent panel, and the hydraulically-operated entrance door is immediately behind.

A modified form of intake is used to admit air to the four Bristol Olympus two-spool turbojets, which deliver more thrust at maximum altitude than do the engines of any other V-bomber. Air brakes remain above and below the wing, but the tail bumper is absent from production machines. The Dowty bogie undercarriage is now even cleaner than before, and all eight main-wheel tyres are braked under Dunlop Maxaret control.

Avro Ashton. This Ministry of Supply test-bed is entered by Rolls-Royce, one of whose Conway by-pass turbojets has been mounted under the belly in a streamlined nacelle. The installation was the work of Napiers; the weight and thrust of the Conway are accepted by a structure of steel tubes, and the nacelle is well clear of the Ashton's pressurized fuselage. Full provision is, or will be, made for all forms of flight development.

Canada's Avro Aircraft CF-100 caught by "Flight's" camera in an attitude that presaged Zurakowski's zestful demonstrations.

Avro Shackleton M.R.3. The first two marks of this long-range patrol and anti-submarine aircraft have been giving good service for some years. The Mk 3 is a redesign, having a tricycle undercarriage and exhaust pipes on each side of its Rolls-Royce Griffons, which make it very much quieter than before. The wing plan-form is extended at the tips and terminated by permanently mounted tip-tanks, which indicate increased all-up weight. The pilot's canopy is of a new clear-view type and the dorsal turret is eliminated.

Dunlop twin nose-wheels are mounted on a Dowty leg, while the twin main units, with disc brakes and Maxaret, are by Electro-Hydraulics. In this version the Shackleton is to be supplied to the South African Air Force.

In the ascendant once more: the Comet 3 displaying to advantage its pinion tanks and the fairings between them and the leading edge.

Avro Canada CF-100 Mk 4. Nine squadrons of these all-weather long-range fighters are now in service with the R.C.A.F. and four squadrons are to join the Canadian air division in Europe. The aircraft at Farnborough have been carrying out trials at West Raynham and are to go into store at Langar after the show. They are equipped with the Hughes fire control system, whose gun-sight images are reflected on to a large glass screen covering the windscreen. The engines are Orenda 11s.

A plastic inner blast shield immediately in front of the navigator shields him from turbulence after the hood is jettisoned, so that he can reach the ejection seat firing handle.

Empty weight of the CF-100 is 24,408 lb. Eight 0.5in machine guns are carried in a pack under the fuselage and supplemented by expendable rocket pods at the wing-tips. These latter can be replaced by long-range tanks if desired, still further increasing the already very long endurance.

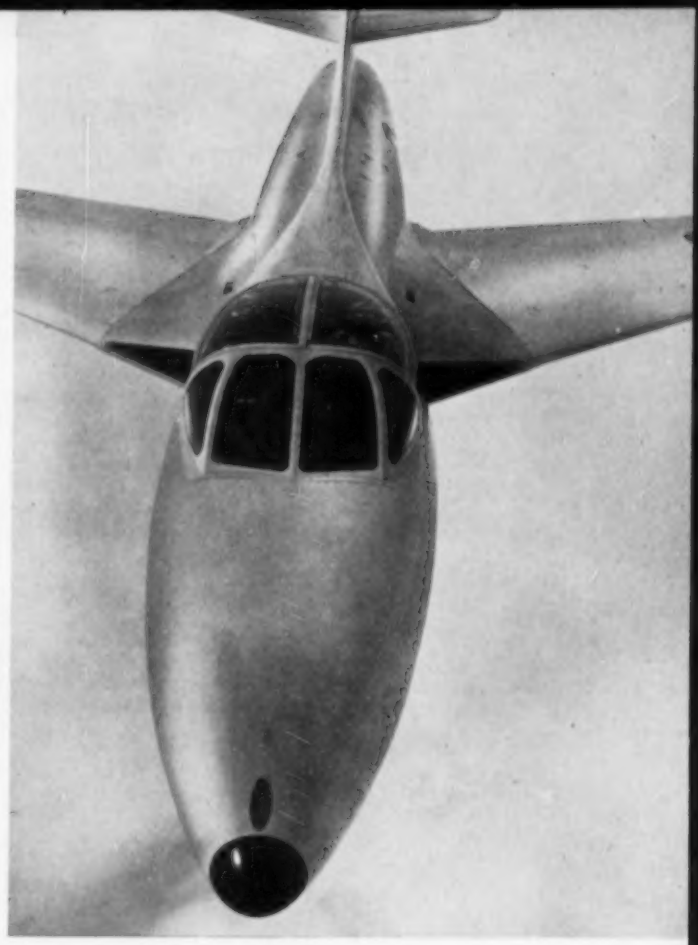
Electric de-icer boots are fitted on all leading edges and triggered by an ice-detector, and free-turning vanes in the intakes are used to spray de-icing fluid.

Blackburn Beverley. The Beverley shown statically (XB 263) is the fifth of six production aircraft completed to date. It displays features of both military and civil interest. Transport Command passengers will applaud the handsome blue and grey styling and rearward-facing Blackburn chairs in the 42-seat tail boom.

The load for the main hold consists of three Army vehicles and miscellaneous stores. The method of stowage will appeal strongly to potential civil users of this mammoth freighter; the hold is separated laterally by rails running along each cabin wall at a variable height determined by the vertical clearance of the "ground-floor" load. These rails will support up to 12 tons of cargo on a floor made up of cabin-width pallets which are pre-loaded and fork-lifted into position at the rear loading door. As might be expected, recent progress with the Beverley has resulted in marked hardening of civil interest in the Universal, the commercial version. It is encouraging to know that as much C. of A. testing as possible has been included in the military development programme.

Bristol Britannia 100. The current tempo of the pre-service test and development programme precluded the appearance of a production Britannia at Farnborough, so the type is once again represented by G-ALBO, the first prototype. No significant modifications have been embodied in this much-flown machine since its last appearance and the design may now be considered as firmly stabilized. Latest news of the pre-service programme was that G-ANBC should have set off on the first of a series of overseas flights before these words are printed. Four Britannia 100s are due for delivery to B.O.A.C. before the end of the year, and scheduled services to South Africa should begin in April next. The larger, more powerful 250/300-type Britannias are represented in the static exhibition by large scale models, two of which show proposed interior layouts for the Mk 300 L.R.s of B.O.A.C. and El Al Israel Airlines. Another unmarked model, depicts a high-density (trooping?) version of the Mk 300.

Bristol Olympus-Canberra. Proudly bearing notice of its recent world altitude record (65,876ft or 20,079 metres), WD 952 is flying at the show with two of the very powerful Olympus BOl.11 turbojets. As noted in our news-item announcing the height record, the airframe can now fully utilize the great thrust of these engines. The large one-piece cowlings are arranged to be removed forward; there are no separate hinged panels for access to the engines. Outlets for cooling air are very prominent above and on the port side of each cowling.



(Above) The newest Hunter—the Two-Seater—aroused great interest on Monday. The crew are accommodated side-by-side in Martin-Baker light-weight seats.

(Left) In a demonstration of slow flying the Handley-Page Herald shows its high-mounted wing and large-area flaps.

(Below) G-ALIK, originally a Dragonfly prototype, now re-emerges completely rebuilt as the Widgeon 4/5-seater. The whole forward port side of the cabin hinges for admittance of stretchers.

THE OPENING OF THE SHOW . . .

The Fairey Jet Gyrodyne, Alvis Leonides-powered and forerunner of the Rotodyne, flies over with a strange and individual noise—a composite of roar and thrash.

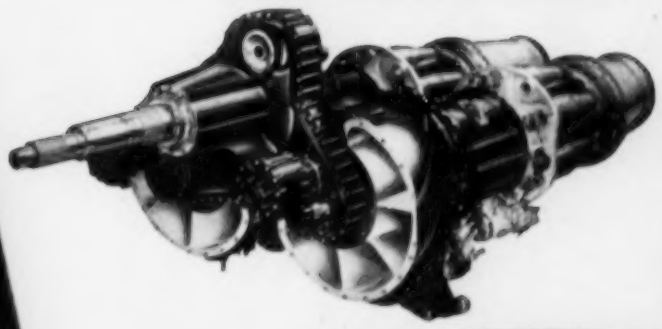
Most attractive of its strain, the Shackleton M.R.3 appears in a handsome coat of grey and with tip tanks. Its four Rolls-Royce Griffons are much quieter with their new exhaust systems.

This Hunter apparently has no objection to its assorted asymmetric load of rockets, tanks and bomb.

In spite of its high thrust, the Rolls-Royce Conway in its nacelle under the Ashton test-bed looks quite small by comparison with the paired Nenes of the mother ship.

The POWER of Armstrong Siddeley

The Fairey Gannet carrier-operated torpedo bomber of the Royal Navy owes its long range and economical cruising to the Armstrong Siddeley Double Mamba turboprop. This unique design provides twin engined performance and safety factor with the fuel economy and stowing facilities of a single engined installation.



ARMSTRONG SIDDELEY

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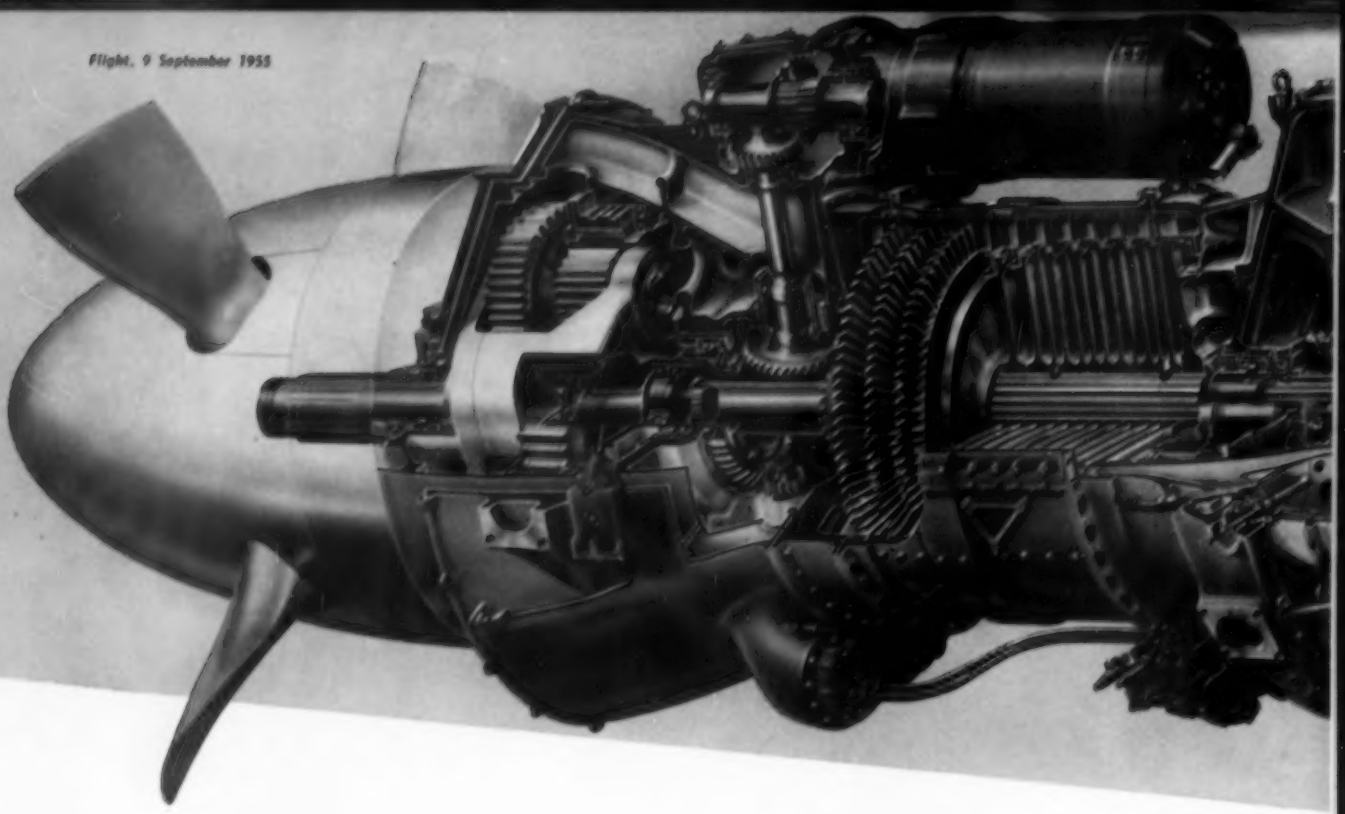
Members of the Hawker Siddeley Group



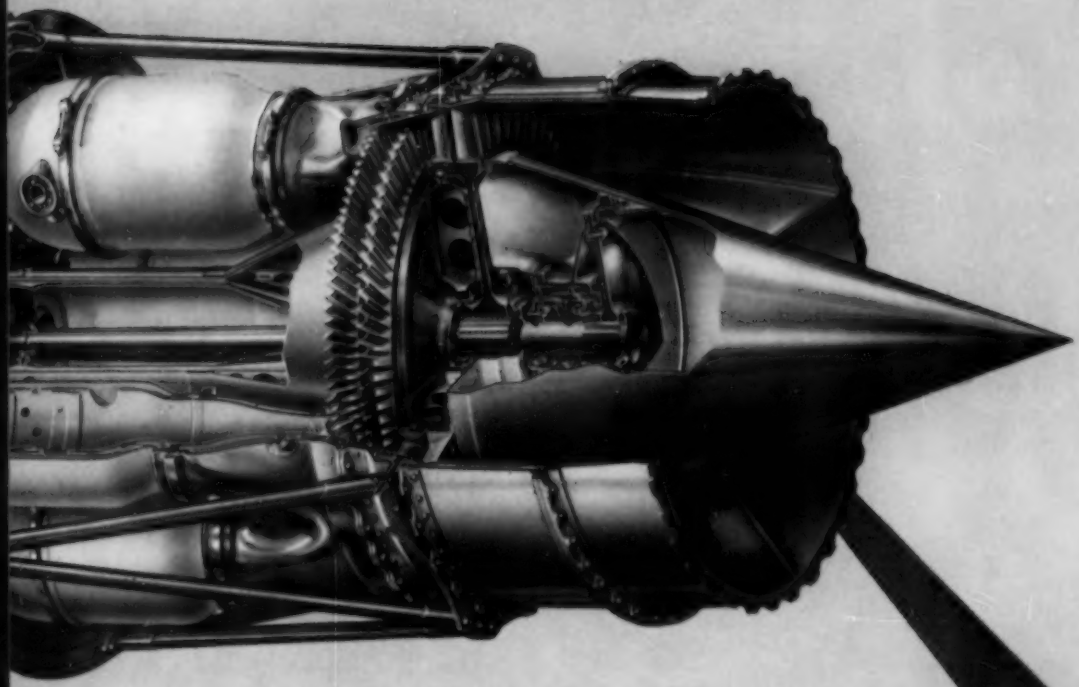
see **NAPIER** on stand G at Farnborough

With the **Eland** turbo-prop Napier offer a range of gas turbine engines to meet a wide variety of needs in world air transport. These engines feature reliability at all altitudes, simple and safe automatic control, high power/weight ratio, simplicity of maintenance and economy of fuel consumption. The 3,000 e.h.p. **Eland** has reached the Type Test stage, and a 4,000 e.h.p. version is now running. Still higher powers are on the way.

Napier are specialists in the application of the gas turbine to rotary wing aircraft and have a series of engines designed specifically for this purpose.
A particular version of the **Eland** incorporating an auxiliary compressor for the tip-powered rotor system will be used in Fairey's large transport helicopter—the Rotodyne.

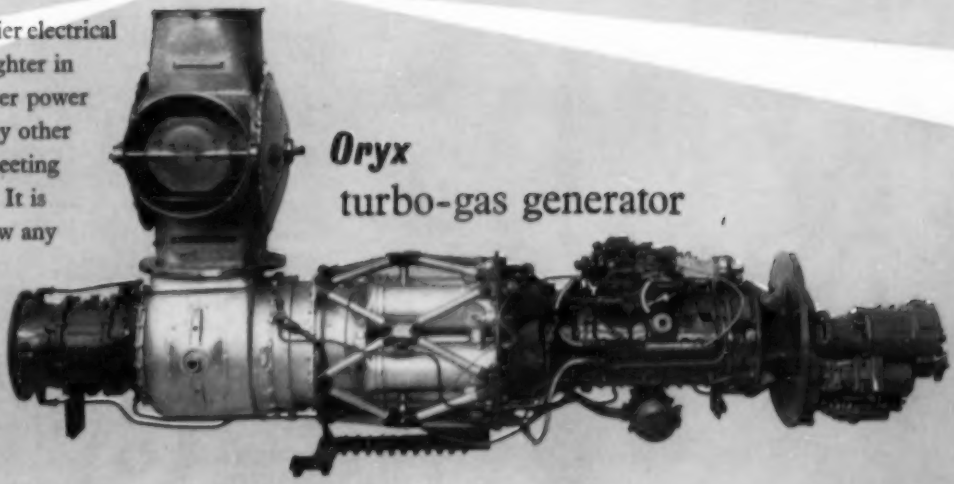
Napier are also working with Hunting Percival in the development of the **Oryx** 750 gas h.p. turbo-gas generator as a power unit for the P74 helicopter—an entirely new form of helicopter propulsion which eliminates all mechanical transmission.

Partners in Progress with The ENGLISH ELECTRIC Company Ltd · D. NAPIER & SON LIMITED · LONDON, W.3.

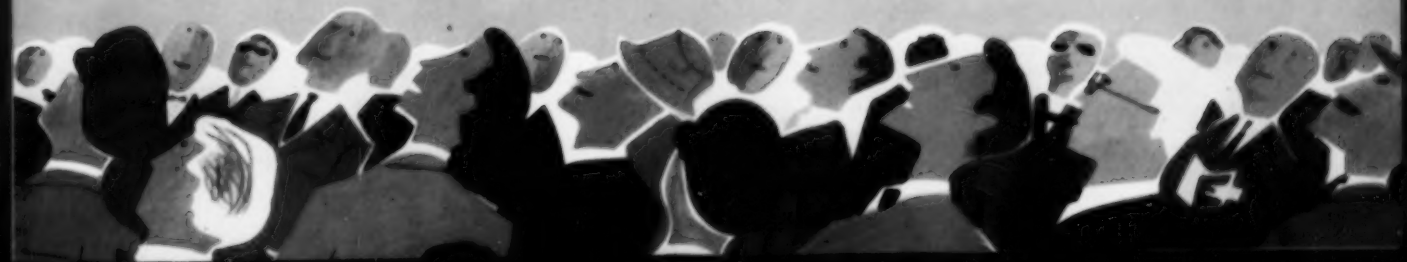


Eland
turbo-prop

Spraymat, the Napier electrical de-icing system, is lighter in weight and has a lower power consumption than any other method capable of meeting design requirements. It is sprayed on, can follow any contour, is easily repaired and resists sand, rain, fuels and hydraulic fluids. It can be applied to aircraft in service or to new designs.



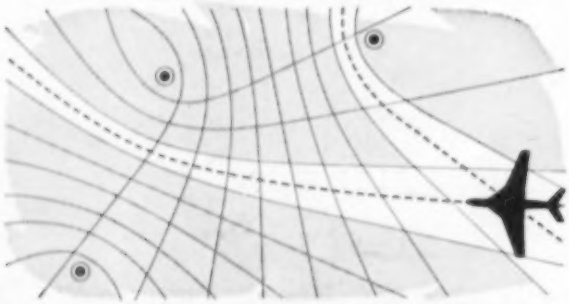
Oryx
turbo-gas generator



Problems of flight

ON THE BEAM

By flying down a beam pilots can come into an airfield they cannot see and could not possibly find. With this invaluable technique man has rediscovered a gift he may once—long ago—have had : one that many creatures have in highly developed, highly efficient form.



Butterflies cross seas and make safe landfalls; the Chinook salmon swims oceans and returns, infallibly, to the very pool of the very river in which he was born ; a pair of finches divide their year, season after season, in a particular bush in an English garden and another in a North African orchard. Most astonishing of all, the homing pigeon can be taken in any direction, for any distance, and after a turn or two in the air will fly unhesitatingly straight for home.

How does the pigeon do it ? We do not know. We may never know. It is not sight, nor smell. If it is sense of direction, this must be developed to a degree of sensitive infallibility which puts it clear beyond human understanding. We can only say that —like hundreds of kinds of migratory creatures— the pigeon feels some mysterious, unmistakable pull towards home : that he senses some "radio beam" that gives him his direction.

Though we may never know the mechanics of the homing pigeon's "beam", we imitate its effects. Landing under any but the best daylight conditions can be difficult indeed without this navigational aid we have copied from Nature.

Pilots who come in to land on a beam or off it, have come to value, at all Britain's major airfields, the excellent and helpful service of the Shell and BP Aviation Service.

SHELL and BP AVIATION SERVICE

Shell-Mex and B.P. Ltd., Shell-Mex House, Strand, London, W.C.2.

Distributors in the United Kingdom for the Shell, BP and Eagle Groups.

Copies of this advertisement can be obtained from Shell-Mex House.

Sixty tons of Blackburn Beverley charging on its way to Farnborough from the flat reaches of the Humber. It is the fifth production machine, serial XB 263.

THE OPENING OF THE SHOW

Bristol 171. The Mk 4 Sycamore taking part in the flying display is Bristol's familiar unpainted demonstrator, G-AMWI. It is equipped as a four-passenger version, with rescue winch and provision for stretcher-bearing. First flown in 1947, the Sycamore is serving with the Army, B.E.A., R.A.F., R.A.N. and Belgian Air Force, and production is continuing to a "substantial" M.o.S. order.

Bristol 173. XH379, the burnished aircraft flown in the display, is the second prototype of the 173 Mk 2, and is the machine which recently flew from the South Bank to Le Bourget in two hours. Since the last S.B.A.C. Show it has been equipped with four-bladed rotors conferring a pronounced improvement in smoothness of cruising flight. A more powerful version of the Type 173, equipped with 850 h.p. Alvis Leonides Majors in place of the two 520 h.p. Leonides now fitted, has been completed and should make its first flight shortly. The Type 173 will not be produced as such but is leading the way to the basically similar Type 191 Naval anti-submarine helicopter, which is demonstrated by a model in the static exhibition. A similarly scaled 173 is close by for comparative purposes. The tandem-rotor configuration proved by the 173 will certainly be featured in at least one turbine-powered helicopter from Filton.

de Havilland D.H.110. Seen for the first time at an S.B.A.C. show, XF 828 is designated Mk 20X, and is an interim third prototype embodying some, but not all, of the equipment needed for service as the Fleet Air Arm's future carrier-based all-weather fighter. Aerodynamically it resembles the second machine, with an all-flying tail (incorporating a separate elevator which is brought into use as a separate surface when the flaps are lowered), large wing fences and Fowler flaps.

New features in XF 828 include an arrester hook and provision for armament. The latter includes a large rack under each wing (for heavy stores, which in service will probably be missiles) and four 30mm Aden repeater cannon. The Adens are mounted under the cockpit floor on a demountable pack, and ready access is provided for the ammunition loader and gun-hoist winch. Other features include the installation of an advanced form of radar, a new design of pilot canopy and a temporary, experimental air brake under the gun pack, which is currently imposing a limit on maximum indicated air speed. Small red linear potentiometers are attached to each control surface, and a whip aerial is visible above the fuselage.

The Christchurch factory are now getting production under way with the Mk 20, a fully operational machine with power-folding wings, a steerable nosewheel and other refinements. Engines of all 110s have been increasingly powerful Avons.

de Havilland Venoms. Both the single-seat F.B.4 and the two-seat F.A.W.21 are in the static park, and both have powered ailerons as the principal new feature. The Mk 4 is now in service with squadrons of 2nd T.A.F. in Germany and with several other air forces, and the F.A.W.21 is going into service with the Fleet Air Arm. Principally employed for ground attack, the Mk 4 is surrounded by representative loads of 1,000 lb and 500 lb bombs, and of rockets.

de Havilland Vampire T.11. Now in full service with the R.A.F. and 18 other air forces, the Vampire Trainer is no newcomer to Farnborough; but it is representative of the type of aircraft which is in current large-scale production for both home and overseas customers. The example shown in the static park, XH276, is complete with central blind-flying panel, two Martin Baker Mk 3 ejector seats, clear-view canopy and extended dorsal fins. Laid out round it are armament loads and wing-tanks.

de Havilland Chipmunk. This delightful light aircraft, which was formerly the mainstay of the R.A.F.V.R., is represented by G-ALWB, a company aircraft. Though low powered, the Chipmunk is still in service with 21 air forces.

de Havilland Comet 3. Externally, G-ANLO appears to have suffered few changes since its maiden appearance at Farnborough last year. The aircraft is intended, however, to serve as a development vehicle for the Comet 4 and it is hoped to complete 80 per cent of Series 4 C. of A. trials before the later machine is ready for flight. Accordingly, the Comet 3 has been modified where possible to Series 4 standards. The most obvious change is an increase in the capacity of the external fuel tanks, each of which houses 200 gallons more than those originally fitted. The small forward-swept fairing inboard of each tank exhibits three parallel, chordwise slots, presumably to improve air flow at low speeds. Another minor wing modification is the adoption of a small boundary layer fence and knife edge on the top surface approximately mid-way between intakes and leading-edge tanks. The split flap beneath the fuselage is no longer featured on this prototype. The cabin is furnished to B.O.A.C. luxury standards, as demonstrated by the large scale model of the Comet 4 which is to be seen on de Havilland's stand in the static exhibition; this has 58 fully reclining seats in two compartments—26 forward and 32 aft—the two compartments being separated by a structural bulkhead.

Versatile, agile and cheap to maintain, Fairey's lightweight helicopter is designed to British Army requirements. It is the first machine to be powered by a Blackburn Palouste, and the first British "turbocopter."

Looking more than ever like a monster of the deep, 90 potential tons of Avro Vulcan B. Mk I was upward-rolled beautifully by Roly Falk.

THE OPENING OF THE SHOW

(Below) *Tenth off the Luton line, XD 694 is the first Hunting Percival Jet Provost to have the short undercarriage. Another major change is the use of a hydraulic system.*

D.H./Napier New Elizabethan. A handsome name for a handsome aeroplane, the title New Elizabethan (rather than the more mundane Eland Ambassador) is intended to stress the true purpose of re-engining prototype G-ALFR *Golden Hind* with 3,000 h.p. Eland 1 turboprops. The aircraft is a demonstrator rather than a test-bed, its rôle being to persuade potential Eland purchasers of the advantages of re-powering existing types of piston-engined airliners with these promising Napier units. An obvious candidate for this treatment is, of course, the Convair-liner, and it is well known that Napiers have themselves almost completed the first Eland-Convair combination. Being tailored to the existing Centaurus bulkheads of G-ALFR, the New Elizabethan's nacelles do not perhaps show the Eland at its best; jet efflux, incidentally, is exhausted on the outboard side of each nacelle through a short tail-pipe. Nevertheless, the elegant appearance of the aircraft has suffered little. Not only does it sound exceptionally quiet in the air but, we were assured, noise level in the fully furnished 47-seat cabin is abnormally low. Crew members converse comfortably without intercom.

de Havilland Heron 2. Now that the Heron is so well established in airline service there is an increasing demand for executive versions. Two examples are shown at Farnborough. An innovation shown by G-ANCJ is the use of feathering D.H. airscrews, developed primarily to meet United States requirements. In the static park, G-AMTS provides a close-up view of a typical "custom-styled" interior, with its eight seats grouped in four facing pairs with tables between.

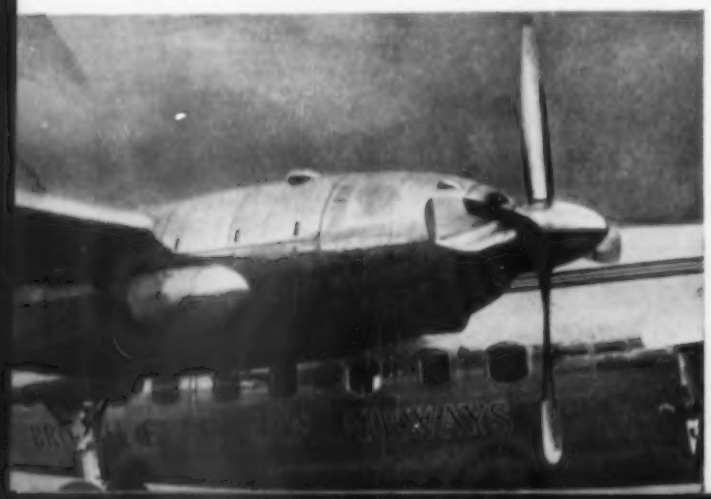
de Havilland Dove. No Farnborough Show would seem complete without a Dove. This year the breed is represented by de Havilland's executive demonstrator, G-AMZN, lavishly furnished for five passengers.

de Havilland Beaver 2. Canada's best-selling bush transport is represented in the static park by G-ANAR, the Leonides-powered Mk 2. It has seating for six, including pilot.

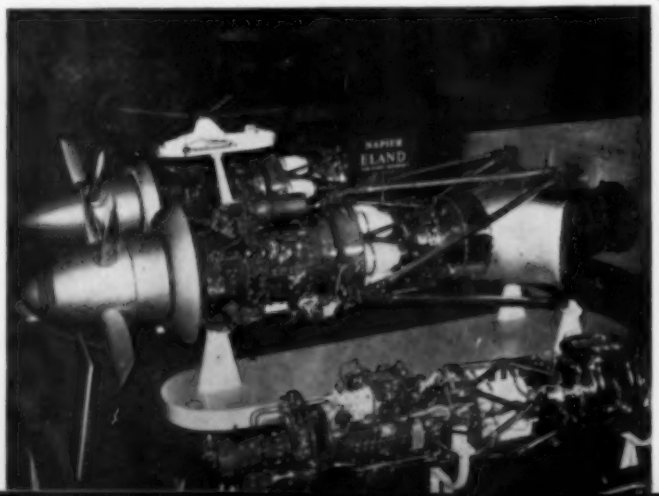
English Electric Canberra T.4 and B.8. A Canberra T.4, with "solid" nose and side-by-side seating for two pilots, is shown in the static display. The night intruder B.8, which figures in the flying display, is now camouflaged on top, but retains its glossy black coat on the under-surfaces. Though the underwing bomb-pylons are absent this year, the machine is virtually unchanged. The offset hood, incidentally, is to be a standard feature of all future machines, whatever their role. Apart from giving the pilot a better view, it entails a rearrangement of the cabin by which the crew sit in front of the pilot. They have a normal parachute exit door, with airstream shield ahead of it, and only the pilot retains his ejector seat.

Fairey Delta 2. Displayed in public for the first time, WG 774, powered by an afterburning Rolls-Royce Avon, is one of the fastest aircraft yet designed in the Commonwealth. The control surfaces comprise ailerons, elevators and rudder, all being fully powered by Fairey Hydroboosters, and installed close up against the airframe, with no gap. There are no tabs anywhere on the aircraft. The elevators are of the plain hinged type with a very large chord. The wing has a thickness/chord ratio of about five per cent, although the leading edge is relatively rounded. Dive brakes comprise four large petals disposed around the tail-end of the fuselage.

Starboard Napier Eland installation in the New Elizabethan, showing the jet-pipe efflux outboard. Airscrews on this machine are Rotols.



Napier engines in toto: Oryx (foreground), E.151 Eland for the Rotodyne (see p. 452) and fixed-wing Eland. A Rotodyne model appears above.



Fairey's Jet-Gyrodyne taxies in after its quiet autorotative landing as the Whirlwind H.A.R.5 (Alvis Leonides Major) gets away easily on 870 h.p.

The 52ft-long fuselage is hydraulically hinged behind the cockpit to the forging to which is also attached the nose undercarriage; for take-off and landing, the nose can be lowered drawbridge-wise to provide the pilot with sufficient view. The nose probe carries a yaw-meter, pitot heads and an aerial, and also incorporates a flush dielectric surface on its under-side. Air is admitted to the Avon through a razor-edged intake in each wing-root, which leads direct to the entry to the compressor, the boundary layer being diverted through four-channel volutes which eject above the wing. The main undercarriage units are of the levered suspension type with the shock-absorbing cylinders in tension. High-pressure Dunlop tyres (28 × 5.25-18) are fitted to thin wheels carrying two-piston disc brakes with Maxaret. Each unit folds into a narrow wing bay.

Fuel is carried in wing and fuselage tanks, and the Avon afterburner has a flameholder assembly comprising one annular and six radial gutters, the final propelling nozzle having upper and lower hinged eyelids.

Fairey Jet-Gyrodyne. XJ 389 has been flying in its present form for about 18 months and has already proved most of the "difficult" fundamental features of the much larger Rotodyne. The Alvis Leonides drives two pusher propellers *via* mechanical shafting, and is also coupled to a centrifugal blower which supplies air to tip-jets on the rotor. For take-off, air is supplied to these jets to bring the rotor up to speed, whereupon, with a marked detonation, petrol is fed to the tip jets and lit.

The rotor has two broad blades attached to lengthy non-lifting root members, and the disc diameter is just short of 60ft. Once established in forward flight, the tip jets can be switched off and flight maintained on the power of the airscrews and the air compressor alone. The rotor has one central spar and skin applied in continuous strips from root to tip, the aerodynamics and control of the blades being generally similar to those which will be adopted on the Rotodyne. Yaw control is provided by the propellers, the pitch of which can be inched electro-hydraulically to the desired value, a differential movement being available for yaw and collective pitch for thrust in cruising flight. Directional stability is provided by two fixed fins and a trimming elevator allows hands-off cruising.

Fuel is supplied to the tip jets by tank booster pumps and a rotor-driven pump, centrifugal force providing the required pressure at the tips. A recent modification is a valve on top of the distributor tank above the rotor hub which ensures that the flow is divided equally between the two rotors. Pitch of the main rotor is effected hydraulically, and handling is very good.

Fairey Ultra-Light Helicopter. Designed to a British Army specification, this useful vehicle is in small-scale production. The machine in the flying display, XJ 924, is not quite standard, the final form being exhibited on the company stand in the static show.

Power is provided by a Blackburn-Turboméca Palouste compressor, which delivers air through a lagged pipe inside the transparent cabin leading to tip jets on the two-blade rotor. Tip burning is employed, but it is ultimately intended to be able to cruise without it. At present the life of the jets is relatively short, but this is being progressively extended. Ordinary M.T. fuel can be used.

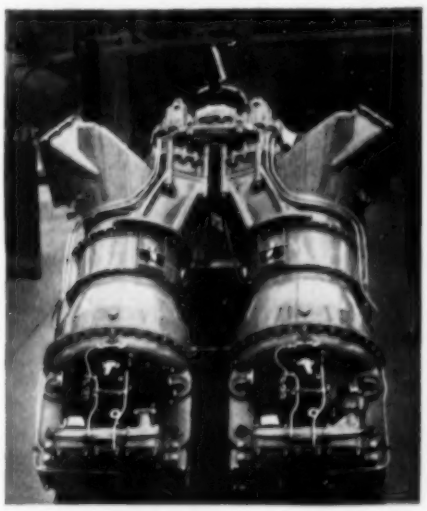
Originally a tailplane and three fins were fitted (picture last week), but there is now only one fin, with stainless-steel skin, mounted behind the jet efflux from the engine. Owing to the high ambient temperature on the fin, the red, white and blue "fin flash" is applied to the girder-type tail boom. General handling is very pleasant, and cabin temperatures are not noticeably raised by the presence of the air delivery pipe. Doors have been off during the test flying. The built-in de-icing should enable the machine to fly in all weathers and the view is superb. There are two seats, the port seat being fitted to face forward for dual instruction or rearwards in an A.O.P. role. Wheels can be fitted to the landing skids for ground manœuvring.

Fairey Gannets. Both the A.S.1 and T.2 are represented; both are already in service with the Fleet Air Arm and the Royal Australian Navy. The T.2 is a pilot trainer and has a weapons bay but no "dustbin" radome. The A.S.1 in the

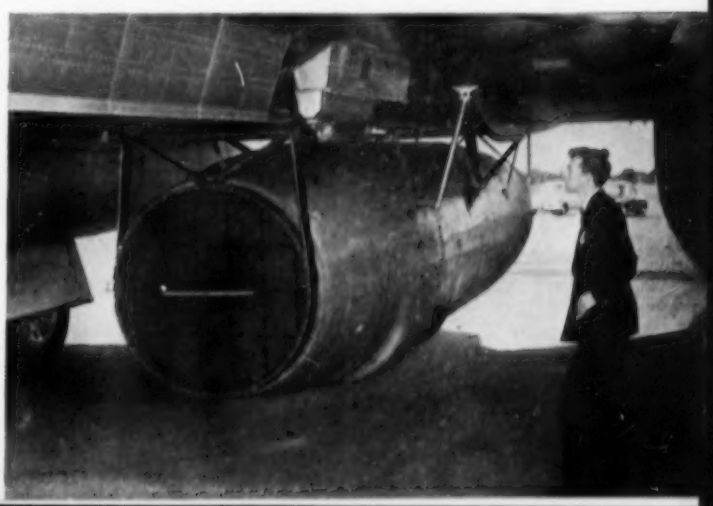
S/L. Tennant rolls off smartly to starboard in the Folland Gnat, closing the undercarriage fairings (employed as speed brakes) preparatory to accelerating violently on the power of the Bristol Orpheus.

static park is surrounded by a vast assortment of stores of all kinds, ranging from racks of practice bombs, through large air/sea rescue containers to 500 lb, 1,000 lb and 2,000 lb mines. Sono-buoys are included, and flame-, smoke- and noise-producing floats, but no direct anti-submarine weapons other than special bombs.

Folland Gnat. Now repaired and flying after its belly landing, the Gnat—pale blue and registered G-39-2—looks as handsome as ever. Though gun-bay access panels are fitted, there is as yet no provision for gun-ports.



The 910 s.h.p. Coupled Turmo on the Blackburn stand. Below, Iob Blackburn of "Flight" provides a scale for Napier's installation of the Rolls-Royce Conway in the Ministry of Supply Avro Ashton test-bed.



Bearing a serial outside the batch for the first B. Mk 1s, this Valiant did a very tight turn at about 200 knots, with air brakes open inboard of the under-wing tanks.

Perhaps it was by intention that Handley Page have painted the second prototype Victor in the colour of war-time photo-reconnaissance aircraft: cerulean blue. In any case, it looked better than ever before.

One-quarter of the 64 Hunters from Fighter Command which flew past in impeccable formation.

THE OPENING OF THE SHOW . . .

The aircraft is finely built and extremely clean in outline. In such units as the undercarriage there is ample evidence of Folland's careful detail design and weight-saving. Inboard drooping ailerons and "all-flying" tail will greatly increase manœuvrability at high and low speeds, and the large jet-pipe indicates the high power of the Bristol Orpheus.

Hydraulic fluid, oil and two fuel filler caps are all located in the dorsal spine within easy reach from ground-level.

Gloster Javelin F.A.W. 1. Two Javelins are at Farnborough, one of them being flown and the other in the static display.

Hawker's Hunter 6—with increased Rolls-Royce power and Bristol reinforced-plastic under-wing tanks.

XA 563, which flew on Monday, is approximately the twentieth production Mk 1. It is claimed to be an entirely standard service aircraft with the "kinked" leading edge, V.I. tailplane and powered elevator, Maxaret brakes, and a new pointed plastic radome. Javelins are now being delivered to various Service test establishments prior to going to the squadrons.

Handley Page Victor. Now resplendent in pale blue, WB 775, the second Victor, shows comparatively few alterations since last year. The dorsal fin is slightly altered and contains a dielectric section, as does the nose of the bullet on top of the fin. A row of retractable spoilers has been added immediately ahead of the bomb-bay, and skin joints indicate the possibility of a retractable section of under-fuselage immediately aft of the bay, in the same way as the Valiant.

Efflux separator fairings appear between the jet-pipes on each side, and the windscreen clear-vision panels raise a small spoiler when opened. Reinforcing strips are riveted to the fuselage in way of the effluxes and the strakes at the edges of the air brakes, at the same level, have been greatly reduced.

Each main undercarriage carries eight wheels and four Maxaret units. The tail-bumper is a smooth-tyred wheel shrouded with rubber sheeting.

Handley Page Herald. The flawless finish of the first prototype Herald gave no hint of the intensive—and highly encouraging—test flying which preceded its journey to Farnborough last Sunday. The white and silver painting of its smooth, low-slung fuselage is relieved by the red flash and lettering of Queensland Airlines, No. 1 Herald customer, and the big, uncompromising white fin bears the Australian flag and the registration G-AODE. The Herald's pressurized cabin, no less spick and span, demonstrates the composite passenger-freight layout, a large cargo space forward being separated from the 26-seat passenger compartment by a quickly removable bulkhead. Fully in keeping with the sturdy, logical appearance of the Herald are its Electro-Hydraulics undercarriage and the clean, close-fitting cowlings of the four 870 h.p. Leonides Majors.

Hawker Hunters. A whole galaxy of Hunters is on hand, ranging from the brand-new two-seater, and hitherto unpublished F.R. variant, through the Mk 6, with higher-powered Avon, to the heavily loaded ground-attack version. Finless plastic wing-tanks, made by Bristol, are attached to all but the trainer, and are marked as holding 100 gal. WV 385 is claimed to be a standard Mk 4 and carries a plastic tank and four tiers of three air-to-ground rockets under the starboard wing and a tank and a 1,000 lb. streamlined bomb under the other. The tanks can be carried either on the outboard or inboard pylons.

WW 593 is the Mk 6, carrying two 100-gal plastic tanks, but not fitted with outboard pylons. It is identical with the Mk 4 except for an enlarged tail-pipe which does not, however, contain an afterburner.

XJ 615 is the trainer, finished in Neville Duke's well-known duck egg green. Again it is, aft of the intakes, identical with the Mk 4, but forward of this point the nose is entirely new. The cockpit has two gunsights (only one fitted as yet) and two Martin Baker Mk 4 lightweight seats. The canopy is a fine piece of plastic moulding with ample clear vision, and the standard radar nose-cap and camera gun-port are fitted. Two 30mm cannon are fitted in large streamlined boxes under the cockpit with their barrels protruding well clear and far along the troughs. The installation is not in the form of a gun-pack and no link or case chutes are yet in evidence.

Most unexpected arrival is the F.R. variant, again basically a Mk 4. The nose-cap, of standard contour, is detachable to

Quietest machine at the show, in spite of its 15,120 horse-power, was Bristol's Britannia, flown beautifully on Monday by Bill Pegg. This first Britannia, "ALBO," now has over 1,000 hr of flight time.

Geoff Worrall brings XA 563, Gloster Javelin F.A.W.1, past the crowd at 140 knots. If Britain can really make dielectric noses as sharp as this we are one up on the rest of the world.

expose no fewer than six cameras, two looking sideways, two downward oblique, one forward oblique and one straight forward. It carries the standard gun-pack and gun camera, but no radar-ranging sight.

Hunting Percival Provost and Jet Provost. Now well established in service with the R.A.F. and foreign air forces, the piston-engined version is represented by a T.53 Armed Provost destined for the Iraqi Air Force. It carries eight 20 lb practice bombs under the wings.

Quite new, however, is the tenth Jet Provost which has been redesigned to incorporate a more powerful Viper, a larger tail-pipe and a completely revised and much shortened undercarriage. Performance has been improved by these modifications, take-off and landing runs being considerably shortened, rate of climb increased by 350 ft/min at sea level and stalling speed reduced by 3 kt. Thrust is increased by 110 lb and all-up weight reduced by 100 lb. Fuel capacity, range and endurance are unaltered. Pneumatics have largely given way to hydraulics.

Hunting Percival Pembroke. Pembrokes appear in the colours of two of the four air forces using this versatile transport. A standard Pembroke C.1 of the R.A.F. takes part in the flying display; designated C.52, the Pembroke in the static display is intended for the Royal Swedish Air Force. Its cabin has accommodation for 10 aft-facing passengers, proves that this air force at least has little to learn from airlines in the matter of interior design.

Saunders-Roe Skeeter 6. The Skeeter 6 at Farnborough is very nearly a production version and bears the serial XK 773 and Training Command yellow stripes. Its Gipsy Major 200 is now giving its full 200 h.p. and the all-up weight can be increased to 2,200 lb by increasing the payload or by carrying an additional 16 gal of fuel in a tank in the port seat. Standard fuel capacity is 23 gal. Cruising at 85 kt the consumption is 11.5 gal/hr. What the Skeeter 6 loses in load, compared with the small jet-driven helicopters, it regains in speed and range.

XK 773 carries a Sperry H.L.4 helicopter artificial horizon. The collective-pitch lever can be disconnected from the throttle to allow autorotative landings and flare-out with the engine idling. The first pilot's collective-pitch lever, now in the centre, is to be moved over to port.

Scottish Aviation Prestwick Pioneer. Some three months ago the Pioneer was awarded a British C. of A., and civil sales are likely to result from the forthcoming Far East tour. The aircraft flown in the display, G-AODZ, is a brand new Pioneer which completed C. of A. tests only last week; it has seats for five, including the pilot, and is in most respects similar to the Pioneers used by the R.A.F. in Malaya.

Scottish Aviation Twin Pioneer. When the display opened the "Double Scotch" had completed some 36 hours' flying. These initial trials have shown that the tractability and vicelessness of its single-engined predecessor are faithfully reproduced in the Twin Pioneer. More detailed performance measurements will follow, as part of the C. of A. programme. Meanwhile, it can be said that the aircraft meets or exceeds all expectations. Take-offs have averaged 85-90 yd and landing runs have not exceeded 100 yd. The generous high wing of the Twin Pioneer, lavishly slotted and flapped, provides a refreshing sight to those who view with alarm the tendency towards "hotter" approach characteristics in transport aircraft. No less encouraging is the high standard of workmanship displayed by the Twin Pioneer's brightly polished airframe. An exceptionally large cabin door gives access to the 16-seat cabin, which is fully furnished and fitted with three-abreast Rumbold seats of a new lightweight pattern; the single chairs weigh only 11 lb each, and double chairs go one better at 21 lb.

Short Gyron-Sperrin. As is now well known, VX 158, the first Short S.A.4 Sperrin, is being used to take the de Havilland Gyron turbojet into the air. One Gyron is used, mounted in the port lower position; another will later be mounted to starboard. The full flight-approved Gyron thrust was obtained on the first flight, and trials from Hatfield are well advanced.

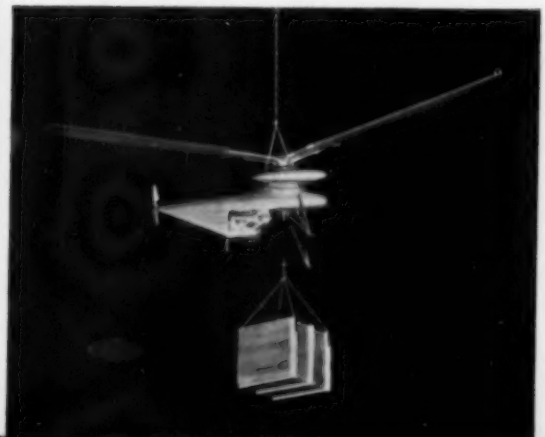
Short Seamew. Four Seamews are at Farnborough, XA 209, the first prototype in Coastal Command colours, XA 213, the second prototype in Naval colours, XE 171 the third production aircraft also in Naval colours, and XE 172, the fourth production machine, in Coastal Command colours.

There are detail differences in all of them, with a variety of aileron hinges and wheel and brake layouts, although the last named are all fitted to starboard of the wheel. All have wing folding, but XA 209 has no arrester hook. All, too, carry radomes. Only XA 213 has catapulting hooks at the undercarriage leg roots.

Jock Elliot put up a fine show in XF 828, the first D.H.110 to come from Christchurch. Here, he is killing excess speed with the "barn-door" and the smaller brakes at the rear end.

Displayed in model form is Hunting Percival's projected flying-crane variant of the Oryx-powered P.105.

Scottish Aviation's Capper brought out all the many remarkable qualities of the Twin Pioneer. It is seen some 80 yd from "brakes off."



RTV-2 displayed by Short and Harland. This massive vehicle was illustrated last week (p. 386) with its booster motors attached to the fore-body. Left, an elegant Fairey missile, described in the text.

THE OPENING OF THE SHOW . . .

The powerplant is the Armstrong-Siddeley Mamba 6, which has a plastic intake ring. The de-icer boots are air operated.

Vickers-Armstrongs Valiant B.1. If the serial WZ 365 be any guide, the Valiant displayed this year is the first of a new production batch (predecessors were serialled WP 199 *et seq*). While the glossy black "one-off" B.2 impressed by its uniquely sinister air, this dull-silver B.1 must be viewed as the representative of an increasingly strong force of Bomber Command Valiants. Further evidence of that strength is to be seen as No. 138 Squadron's Valiants fly overhead—"at 287 m.p.h.", notes a precise Air Ministry announcement.

Vickers-Armstrongs Supermarine Swift. Production of the Swift in a new version is continuing and F.R. squadrons in Germany are to be equipped with them in the near future. XD 904, shown at Farnborough, is claimed to be a standard example of this version. The leading edge of the wing, for just under half of each semi-span, is carried forward some four inches; the cockpit canopy is a new clear-view, single-piece moulding; the Rolls-Royce Avon has an afterburner; the housing and ports of the two inboard cannon have been covered over; the radar nose-cap is replaced, on one of the aircraft shown, by a large metal "dolls-eye" cover for a camera port, and two further panels cover sideways-facing ports.

Another Swift there has windows without covers in these positions; the gun-camera is mounted in the nosewheel door; four pylon mountings can be seen under each wing, together with provision for a large ventral tank under the fuselage. The ailerons carry geared tabs for use in manual control.

Vickers-Armstrongs Viscount 724. T.C.A.'s fourteenth Viscount, CF-TGV, arrived fresh from the Hurn production line to conclude Monday's flying programme, and was expected to demonstrate daily. Since development of the V.724 for Trans-Canada Airlines paved the way to dollar orders worth a total of £34m, there could scarcely have been a more welcome representative of the great Viscount family. Next year's show, perhaps, will see the first appearance of the long-bodied Viscount 800; meanwhile, this development is attractively presented by a large model V.800, in K.L.M. colours, which forms the centre piece of Vickers' stand in the static exhibition. Nearby is a scoreboard recording some salient features of the Viscount story so far—e.g., the number sold (236), airline hours flown (130,010), and the numbers of records held (42) and customers (28).

Westland Widgeon. The prototype of this efficient helicopter is the renowned G-ALIK, the seventh Westland Dragonfly built, which has now logged over 3,000 hr. The cabin is completely redesigned to accommodate side-by-side seats for two in front (with dual controls in a trainer version) and three separate seats behind. In an ambulance role two stretchers (of standard General-Service type) can be loaded, one above the other, through the clamshell-type hinged port half of the nose. Bulged windows provide an excellent view.

The engine remains an Alvis Leonides, driving a three-blade rotor. The rotor head is that of the larger Whirlwind, but the metal blades are of a special type peculiar to the Widgeon. For rescue work, a winch can be fitted to starboard. Maximum weight is 200 lb up on that of the Dragonfly at 5,900 lb, and 6,000 lb is expected with 8 lb boost. Empty weight is 4,424 lb.

Westland Whirlwind H.A.R.5. Now in full production for the Royal Navy, and with characteristics suited to a great variety of Service and civilian roles, the Whirlwind with the Alvis Leonides Major is being shown for the first time. Previously, a mock-up installation of this engine has been displayed in a Whirlwind airframe. The first flight with the Major took place at the end of last month, Lt. "Slim" Sear being the pilot.

The maximum weight has been increased to 8,000 lb, the empty weight being 5,262 lb. Up to 12 troops can be carried in the 10ft by 6ft by 6ft cabin; for a range of 100 n.m. a payload of 2,031 lb can be carried in a block time of 1 hr 20 min, and the service ceiling is 14,500ft at 7,500 lb.

Monday's Flying

IT cannot be claimed that the flying display this year reaches the high standards which have been set in the past. It seemed, in fact, that the demonstrations followed a pattern so constant that the pre-flight briefing must have specified a certain routine. Some of the aircraft were shown for very short periods. Special credit is, however, due for a number of outstanding performances. "Roly" Falk finally performed a splendid upward roll in the Vulcan, an aerobatic feat which he has been prevented only by circumstances from achieving before. Last year, after an accident to the second Vulcan, the first had to be demonstrated at Farnborough and this was not cleared for rolling. Nevertheless, "Roly" took it well over the vertical—and according to reports was roundly upbraided for it. This year there was nothing to limit him and, sweeping down past the control tower in a shallow dive, he pulled up into a steep climb and completed a roll in fine style.

Jan Zurakowski, who left Glosters for Avro Canada some years ago, returned to Farnborough this year to fly one of the CF-100s in the show. His demonstration was short and to the point and in the classic tradition that previous shows have led us to expect from him. He gave a masterly demonstration of flying, while also showing the excellent handling qualities of the aircraft. Out of a fast pass he half rolled and completed an upward bunt, rolled again and went into a spin. Pulling out of this he went straight into a series of upward rolls and then stalled the aircraft and executed a classic falling leaf—this with an aircraft with an all-up weight of well over 40,000 lb.

The No. 11 Group Hunter formation aerobatic team, formed by No. 54 Sqn. and led by Capt. Immig of the U.S.A.F. gave a demonstration which for showmanship and originality of manœuvre was well up to Skyblazer standard. It seemed that the aircraft did not quite give them the controllability in the bumpy air to perform just so precisely as the Skyblazers' Sabres. Most of the time, however, they were if anything closer together than the Americans. Particularly exciting was their roll to starboard, beginning in echelon starboard and changing into box four on the way round. Just to prove that this was routine, they looped in box, winged over into line astern and rolled to port back into box formation. The bomb-burst was beautifully stage-managed. The team, in box, burst from a patch of cloud vertically downwards, to break immediately leaving trails of red smoke from their tails as they pulled out.

Of noise there was plenty, from the gentle rustle of the Gnat at high speed to the shattering roar of the Olympus Canberra, fresh from its altitude record flight. The purposeful sound of the Leonides and Leonides Majors in Pioneers, Provosts, Herald, and in helicopter form in the Westland Widgeon, Whirlwind and Bristol Sycamore and 173 contrasted pleasantly with the infernal cracking and resonant note of the Fairey Jet Gyrodyne.

Perhaps the most curious of outlines was that of the Fairey Delta 2, which lowered its nose for taxying and landing. The long needle nose seemed to be sniffing for some kind of mechanical nourishment in the all-too-sterile tarmac. The Delta held pride of place for speed of touch-down. With the Gnat it shared the distinction of using a tail-braking parachute, but whereas the triple chute of the Delta was jettisoned during the landing run, the Gnat taxied with its single canopy trailing.

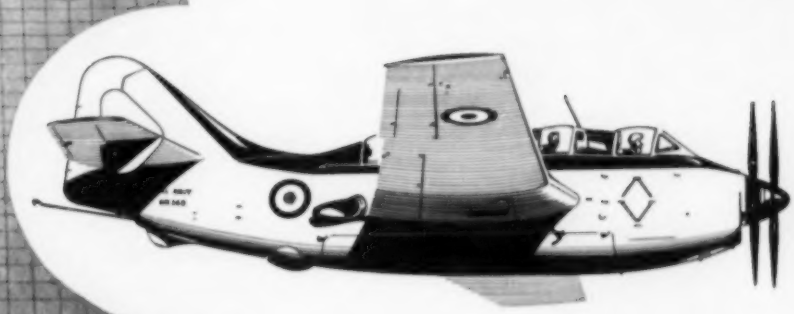
Real progress in the helicopter field was shown by the first appearance of the Westland Widgeon and of the Leonides Major-powered Whirlwind and, smallest but by no means the least interesting, the Fairey ultra-light observation helicopter, powered by a Blackburn-Turboméca Palouste.

Speed was the undisputed domain of the Hunters, Swift, Gnat and CF-100, although the Canberra P.R.9 showed a fine turn of speed as it tore about the sky on the power of its two Rolls-Royce Avon Mk 206s, which give five-figure thrust. Probably the fastest pass of all was that by Frank Bullen in the Hunter F.6, which seemed not at all hampered by its two Bristol plastic wing-tanks.

The Show Dinner

AT the flying display dinner at the Dorchester Hotel, London, last Monday evening, more than 1,200 guests, representing 100 countries, were present. The president of the S.B.A.C., Mr. J. J. Parkes, proposed the health of the guests, saying that the Show had become the premier meeting place of world aviation. Friends from the West Coast of America had told him that it was easier to meet others from the East Coast at Farnborough than anywhere else. The S.B.A.C. was happy to provide facilities for its most redoubtable competitors.

For the guests, the High Commissioner of Australia, the Hon. Sir Thomas White, K.B.E., D.F.C., replied, saying that only the fringe of air transportation had been touched. The Viscount was very much in evidence in Australia, carrying on average a passenger load factor of 85 per cent.



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DE HAVILLAND HERON

MISSILES ON SHOW

PERHAPS this year's exhibition is slightly disappointing in the scope and variety of revelations in the sphere of guided weapon development. From a technical aspect the most interesting exhibit is probably on the stand of the English Electric Group, who are, incidentally, the only private company in the world capable of undertaking the entire design, development and manufacture of a guided missile programme. In such work the English Electric company draw upon the resources of Marconi for guidance systems and D. Napier and Son, Ltd., for propulsion.

An English Electric missile is shown in model form identical with that displayed earlier this year in Paris. The model is, however, painted silver and bears red, white and blue roundels, although it may be presumed that missiles in British service—either with the Army, Navy or Air Force—would not be so painted. The model was described in last week's issue.

More satisfying was the rear end of an actual missile, which was cut-away to show the interior. The body was formed from centrifugally cast sections, bolted together end-to-end. It was understood that the exhibit represented an early test vehicle, in which servicing and maintenance considerations were of minor importance. Production-type missiles will no doubt embody quick-release couplings. The rear end of the body has been belled out to a slightly increased diameter, presumably to allow a cooling airflow to surround the liquid-propellent rocket motor. The latter is a conventional-looking single-chamber unit by Napier. Rectangular spigots can be seen around the extreme end of the outer casing, to carry four booster units. There are four control surfaces mounted in steel fork ends and rotated in roller bearings by hydraulic jacks. The "plumbing," although clearly visible, is not representative of the latest practice.

In front of this exhibit is displayed an electronic pack-unit, hinged along one edge to open out for servicing. The pack is contained in a perforated air-cooled container.

On the stand of Short Bros. and Harland, Ltd., can be seen a complete RTV-2, of the type illustrated in last week's issue. This was originally an R.A.E. design, work on which is believed to have been initiated by Follands before the project was taken over by Shorts. Although it is a test vehicle it is certainly large enough to be a complete weapon, for it has a diameter of 15-17 inches, and the full-weight must be at least 1,800 lb.

The nose is a 20-deg cone, aft of which the body continues to increase in diameter steadily for at least six feet. The tail is of the boat type (which most designers would like, but fail to attain owing to the demands of the power-unit envelope). Cruciform wings are bolted on to the outside of the body, the section being a parallel double-wedge. The tail, in line with the wings, is of high aspect-ratio. As in the English Electric missile, the body sections are bolted together. Around the slightly tapered forward section of the body are sockets for attachment spigots for the four double boosters (which were visible in the photograph published last week). These motors appear to have canted venturis, probably to prevent dispersion in the event of failure of one of them; presumably the thrust-lines are intended to pass through the c.g.

The only other complete missile on show is an elegant vehicle on the Fairey stand. The missile itself seems to be a prototype of an actual air-to-air weapon, although it is shown mounted on the massive booster of an RTV-1 test vehicle. The latter, painted bright yellow, has four dummy motors and simple riveted fins. The weapon itself, which bears the serial number 3401, has an ogive nose, parallel double-wedge wings, a flaired boat tail and rearward-raked tail surfaces indexed at 45-deg to the wings (on RTV-1 the tail surfaces are in line with the wings). The wings have slightly swept leading edges, and the roots are completely recessed in the body. Assuming that the weapon carries its own motor and fuel, we would put the weight, less the booster, at about 300 lb.

Who's the Pilot?

THE MEN FLYING AT FARNBOROUGH

TEST flying is hard work. For most professional pilots today, it comes near to being a vocation; without an enthusiasm and a dedication to the technical purpose underlying every flight, it cannot be followed with success.

Widely contrasting demands are made upon the test pilot, for whom there is little relaxation. When his aircraft is serviceable, he must be ready to fly it, but, inevitably, there are long and anxious waiting periods, both before the first flight of a prototype and subsequently. Yet once he is airborne, the maximum amount of useful flying must be packed into the brief periods available. Between flights his thoughts are naturally occupied with the problems of the test work in hand.

For the general public, influenced by films, magazines, newspapers and popular biographies, test flying is filled with "glamour." To pilots the very word is anathema; and few things seem less glamorous than cold, hard "ironmongery" waiting on the tarmac early on a wet Monday morning.

The Farnborough display is no holiday for the pilots; in fact, on many of them it imposes a severe strain by the end of the week. But at least it represents a change and provides the same pleasant opportunity for a get-together that all the visitors and exhibitors enjoy so much.

Those who are demonstrating aircraft this year—they total more than 60—are shown below and in the following pages, and a few words about their careers accompany each portrait. Many thus noted are holders of numerous decorations, honours and degrees; these are, in general, omitted for the sake of brevity.

In addition, as mentioned below, R.A.F. pilots will do their share by bringing over formations of the latest fighters and bombers now in squadron service.

Three abbreviations occur frequently in the captions below: E.T.P.S. = Empire Test Pilots' School, Farnborough; A. and A.E.E. = Aeroplane and Armament Experimental Establishment, Boscombe Down; R.A.E. = Royal Aircraft Establishment, Farnborough

FOR the daily flying displays, some of the aircraft are grouped together and fly in circuses; the remainder give individual demonstrations. The pilots are depicted in this portrait gallery in the order in which they are expected to perform. Thus the aircraft in circus A are handled by the first eight pilots, right and overleaf. Tomorrow, Saturday, a formation of Valiants of No. 138 Squadron will take part in the display. They will be led by W/C. R. G. W. Oakley, D.S.O., D.F.C., D.F.M. Accompanying them will be 64 Hunters of Fighter Command, in four formations, led by W/C. K. C. M. Giddings, O.B.E., D.F.C., A.F.C., W/C. J. H. S. Broughton, D.F.C., A.F.C., W/C. J. A. Sowrey, D.F.C., W/C. P. J. Simpson, D.S.O., D.F.C. On each public day, the Hunter aerobatic team of No. 54 Squadron, led by Capt. Richard G. Immig, U.S.A.F., and comprising as well F/O. P. V. L. Hamilton, F/O. B. J. Noble, and P/O. K. R. Curtis, will also give a five-minute exhibition.

S/L. MIKE RANDRUP (Eland-Elizabethan): *Charter pilot before war. R.A.F. instructor 1940-41, fighter pilot (Spitfires) in 1942. Since then, test pilot in industry and at R.A.E.; O.C. Engine R. and D. Flight 1945-46. Chief test pilot for Napiers since 1946. 4,450 hr.*

H. K. CARTWRIGHT (Eland-Elizabethan): *D.H. Technical School, 1935-38; Wilson Airways, Kenya, until 1940. No. 30 Sqn. abroad. Returned 1944 to fighter testing. Attached Napiers on Sabre development, remained with company. Has 3,500 hours.*

D. MASTERS (Gannet Trainer): *Senior test pilot, Fairey, Ringway. R.A.F.V.R. 1938-46. Instructor, Rhodesia 1940-1943. Bomber commander 1944-46. No. 5 Empire Test Pilots' Course, Cranfield 1946. Joined Fairey in 1946.*

ROY MORRIS (Gannet Trainer): *R.A.F. 1943-44, then Royal Navy till 1950. Recalled six months later and served as pilot and deck landing officer till February, 1952, when he joined Fairey, No. 12 E.T.P.S. course, 1953.*

Who's the Pilot?

CIRCUSES B, C and D of the flying display programme comprising respectively light and medium civil aircraft, a Canberra and Hunter trio, and the helicopters, are seen airborne under the skilful guidance of the pilots portrayed on this page.

C. D. BEAUMONT (Gyron-Sperrin): *Chief test pilot of the de Havilland Engine Co. since 1946. Joined R.A.F. in 1934 and transferred to R.A.F.O. in 1938. With D.H. School of Flying 1938-40; again with R.A.F. 1940-46.*

R. PLENDERLEITH (Gyron-Sperrin): *Test pilot of the de Havilland Engine Company since 1947. Joined R.A.F.V.R. 1937 and served in Fighter Command during war. In 1944 joined Maintenance Command and was M.U. test pilot until 1947.*

B. RADLEY (Provost): *Hunting Percival test pilot since 1953. Halton apprentice 1938. Night fighter pilot No. 125, R.A.F., test pilot 1946. E.T.P.S. course 1949. Experimental test pilot R.A.E. 1950-52. Sabena pilot for six months before joining Hunting Percivals.*

S/L. R. PORTEOUS (Aiglet and A.O.P.9): *Auster chief test pilot and sales representative. Learned to fly at D.H. in 1935. R.A.F.O. from 1937 onwards. Phillips and Powis (Miles) Aircraft 1938-39.*

CAPT. R. SMITH (Pioneer): *Scottish Aviation assistant test pilot. Joined R.A.F. 1941. Senior captain with Scottish Airlines. Joined present company 1947. Over 8,000 hours' flying.*

S. B. OLIVER (Pembroke): *Joined R.A.F. 1942. Transferred R.N. Air Branch 1945. Instructor's course at C.F.S., 1946. No. 9 course, E.T.P.S., 1950. Naval test pilot, Boscombe Down 1951-52. Released from R.N. 1954 to join Hunting Percival as test pilot.*

G. H. PIKE (Heron 2): *D.H. experimental test pilot. Apprenticed D.H. 1934. Joined R.A.F. Reserve 1936. R.A.F.V.R. 1938 and commissioned 1939. Test pilot in D.H. Engine Co. 1940-42 then transferred to D.H. Aircraft Company.*

D. B. TAYLOR (Heron 2): *Joined R.A.F. 1941. Instructor U.S. Army Air Corps. Served in North Africa, Italy and Greece. Left R.A.F. with the rank of Squadron Leader and was flying instructor and private pilot until joining D.H. in 1949.*

J. W. STILL (Canberra B.8): *English Electric experimental test pilot since 1952. With Fighter Command for six years during war, and with No. 603 (City of Edinburgh) Sqn., of the R.Aux.A.F. Helped train Venezuelan crews to fly Canberras.*

J. W. C. SQUIER (Canberra B.8): *English Electric chief production test pilot; more than 1,000 hr on Canberras. In Battle of Britain, then test pilot in 1941; joined E.E. from R.A.F. in 1946. Has flown 64 different types.*

A. W. BEDFORD (Hunter F.4): *In R.A.F. 11 years, Fighter Command in war and Training Command and M.o.S. in peace. Ex-instructor of E.T.P.S.; also R.A.E. test pilot. Retired from R.A.F. in 1951 to join Hawkers. Holds seven gliding records*

W/C. W. F. GIBB (Olympus-Canberra): *Bristol assistant chief test pilot since Jan., 1953. Apprenticed to B.A.C. in 1937. In R.A.F. 1940–46. Rejoined Bristols in 1946; co-pilot of Brabazon on first flight, September, 1949. World altitude record May 1953.*

G. AUTY (Olympus-Canberra): *Joined R.A.F. 1940; No. 21 Sqn., 2nd T.A.F., No. 62 Sqn., S.E.A.C.; also ferry pilot. Has 2,500 hours on 30 types. Has flown the Avro Vulcan at the invitation of A. V. Roe. Joined Bristols in 1951.*

P. MOORE (173 and Sycamore): *Learned to fly in R.A.F. during war, served as pilot with 607 Sqn. In 1946 joined Cambrian Air Services and became chief pilot. Went to Pest Control in 1948 and converted to helicopters. Joined Bristols in March, 1953*

P. WILSON (173 and Sycamore): *Served in Army during war (Regular commission) and qualified as an A.O.P. pilot. Helicopter test pilot with M.o.S. before joining Bristols in February, 1952. Has flown Sycamore in Malaya.*

C. T. D. HOSEGOOD (173 and Sycamore): *Joined R.N. 1939 and flew catapult aircraft from armed merchant cruisers. After helicopter training in U.S.A., 1944, was appointed Naval experimental helicopter pilot; loaned to R.A.F. Joined Bristols 1948.*

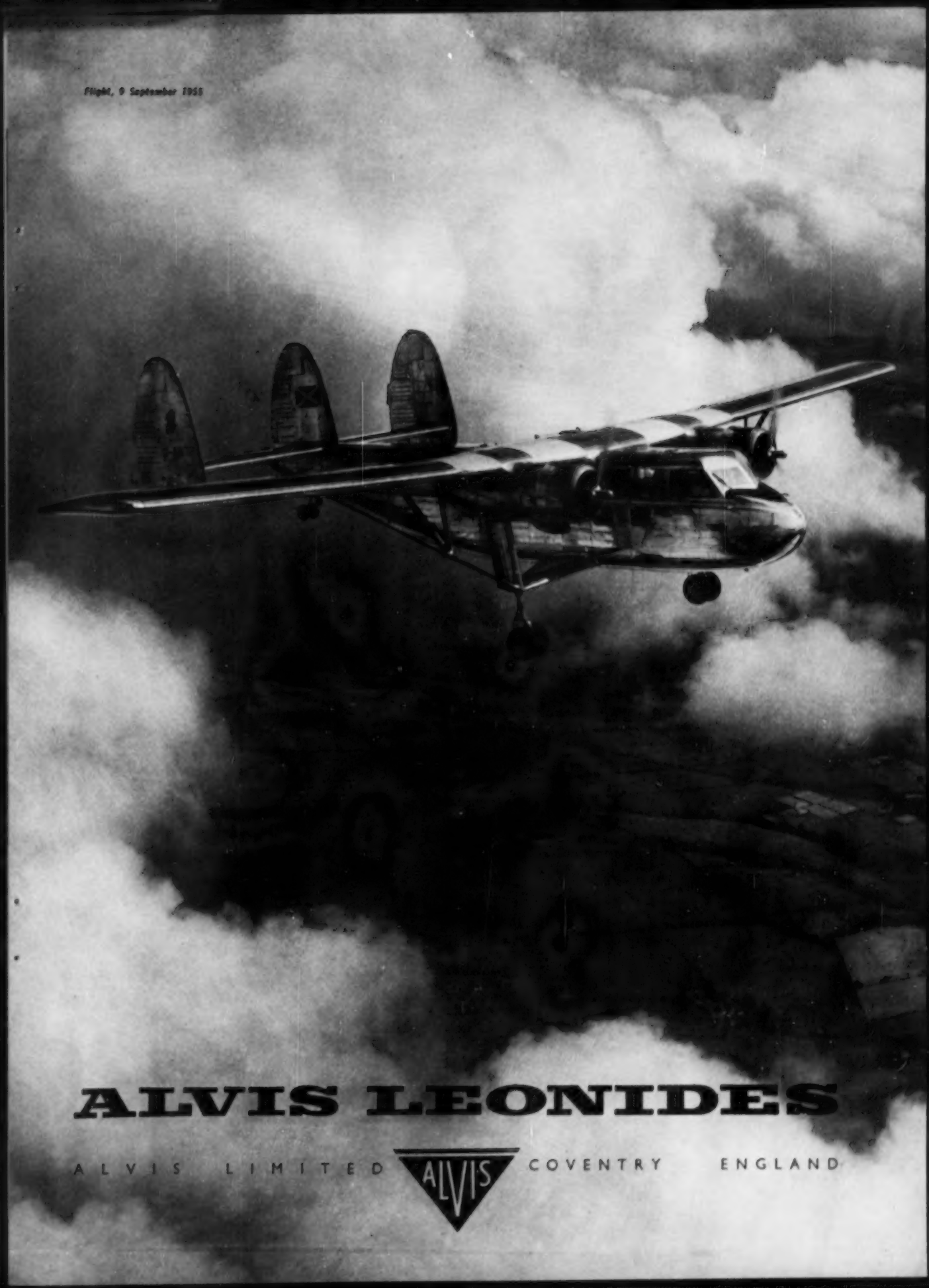
J. J. M. JEFFERY (Skeeter 6): *Joined Fleet Air Arm as pilot 1940. Graduated first helicopter instructors' course, U.S.A., 1943. Naval helicopter test pilot Aerial Torpedo and Air Sea Warfare Development Units 1944–46. To Saunders-Roe as test pilot 1951.*

K. REED (Skeeter 6): *Royal Navy 1941–49. Helicopter course in U.S.A. in 1943; qualified as only R.N. helicopter instructor. R.N. test pilot. Test pilot, Westlands, 1949–52. Formed and commanded R.N. Helicopter Squadron No. 705. Saunders-Roe test pilot 1952.*

Lt. R. BRADLEY (Widgeon): *Westland assistant test pilot. Served in the Fleet Air Arm from 1941 to 1946. Chief test pilot at Helliwells until joining Westlands in 1950 as experimental test pilot. Has flown 4,000 hours.*

S/L. D. C. COLVIN (S-55): *Test pilot, Westland Aircraft; served with R.A.F. 1940–46, commanded No. 249 Sqn., Fighter Command; from R.A.F. to Scottish Aviation on leaving the Service and joined Westlands in 1949. Total hours 4,000, 1,100 on helicopters.*

F/L. J. N. DENNIS (Gyrodyne): *Joined R.A.F.V.R. in 1938. In 1940 No. 139 Blenheim Sqn. In 1942 went to Autogiro Sqn. at Halton; in 1944 to Beaulieu for rotary-wing research and development. Posted to R.A.E. as a Service pilot, 1945, and in 1946 became civil pilot there.*



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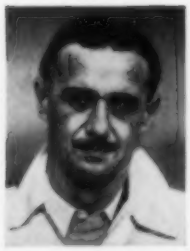
Who's the Pilot?

LAST of the groups of aircraft are the Seamews, whose pilots are shown immediately below; and the flying programme then continues with individual demonstrations. The chief test pilots of several companies will be putting the latest prototypes through their paces; some of those depicted on this page will be flying the latest civil transports.

S/L. W. R. GELLATLY (Fairey U.L. helicopter): *Enlisted R.N.Z.A.F., Jan., 1940. Varied operational experience. At A. and A.E.E. as helicopter flight commander, 1951–54. Joined Fairey in 1955. Flew Duke of Edinburgh in helicopters. Germany. 1954.*

T. BROOKE-SMITH (Seamew): *Test pilot to Short Bros. and Harland since 1942 and their chief test pilot since 1948. Learned to fly at Brooklands in 1935 and served during early war years in A.T.A. Has 5,000 hours on 130 types.*

S/L. W. J. RUNCIMAN (Seamew): *Joined Short Bros. and Harland 1952. Served in R.N.Z.A.F. 1940–46, R.A.F. 1947–52. Tours in Bomber Command, 2nd T.A.F., Central Bomber Establishment, A. and A.E.E. E.T.P.S. 1950. Has 9,000 hours on 50 types.*



W. J. D. EASSIE (Seamew): *Royal Air Force 1939–47. Joined Short Bros. and Harland in 1947 (Flying Schools Division) and in 1950 transferred to test flying at Belfast. Has 3,500 hours on 50 types.*

W/C. M. INGLE-FINCH (Seamew): *Joined Short Bros. and Harland 1952. Served in R.A.F. 1939–47. Hurricane pilot in Battle of Britain; later attached to 83 Group T.A.F., then with B.A.F.O. Has 2,600 hours on 60 types.*

J. KEMPSTER (Seamew): *Went to Short Bros. and Harland in 1953. Served in Fleet Air Arm 1943–48. Has completed 2,300 hours on 25 types. Was at one time in charge of Admiralty Flight at Rochester.*

E. A. HYDE (Seamew): *Served in Royal Air Force 1941–46; was staff pilot, Naval Ferry Pool, 1951–53; joined Short Bros. and Harland 1953. Has completed 2,500 hours on 84 types of aircraft.*

S/L. H. G. HAZELDEN (Herald): *Handley Page chief test pilot since 1947. Joined R.A.F.V.R. in 1939. First course at E.T.P.S., 1943. Appointed test pilot, Heavy Aircraft Sqn., Boscombe Down, and later head of Civil Aircraft Test Section.*

W/C. N. J. CAPPER (Twin Pioneer): *Chief test pilot, Scottish Aviation, Ltd. Joined R.A.F. in 1929. Was later civil pilot with Hillman Airways and Imperial Airways, and R.A.F. instructor. Returned to Scottish Aviation. Over 7,000 hours (300 on helicopters).*

R. RYMER (Viscount): *V-A. test pilot since 1953. Served in Coastal Command and Combined Operations; B.O.A.C. instructor 1946; i/c. B.E.A. training 1949. First airline pilot with turbine endorsement (1950). Queen's Commendation for Valuable Service in the Air, 1953.*

A. J. PEGG (Britannia): *Bristol chief test pilot since 1947. Joined R.A.F. 1921, learned to fly 1925. No. 43 (F) Sqn. instructor. Test pilot, A. and A.E., Martlesham Heath, 1930. Resigned commission 1935 and became Bristol assistant chief test pilot.*

G/C. J. CUNNINGHAM (Comet 3): *Started test flying for D.H. in 1938; chief test pilot since 1946. During war destroyed 20 enemy aircraft. Flew Comet in July, 1949. Is Deputy Lieutenant of County of Middlesex.*

P. BOIS (Comet 3): *Joined R.A.F.V.R., April, 1939, serving in No. 115 Sqn., Bomber Command, to May, 1941. Commanded Ferry Training Unit April, 1942. Afterwards with Transport Command. Joined S.A.S. as captain April, 1946; joined D.H. in 1950.*

P. BUGGE (Comet 3): *D.H. experimental test pilot. Joined Norwegian Air Force in 1939. After invasion escaped by boat to Britain. Joined R.A.F. in 1941. Served with Nos. 604, 255 and 85 Sqns. In 1946 went to S.A.S., flying DC-4s. Joined D.H. in 1949.*

R. G. WHELDON (Jet Provost): *Served with the Royal Air Force from 1936 to 1947. Joined Percival Aircraft in 1947 and became their chief test pilot three years later.*

W/C. R. P. BEAMONT (P.1 and Canberra P.R.9): *English Electric chief test pilot since May, 1947. Was awarded Britannia Trophy (with F/L. Hillwood) for Canberra Atlantic record in 1952. As fighter pilot shot down eight aircraft and 32 flying bombs.*

F/L. P. HILLWOOD (Canberra P.R.9.): *Former flying instructor who began test flying in 1945 while still in R.A.F. Has flown Canberras at S.B.A.C. displays 1950–54. With W/C. Beamont was awarded the Britannia Trophy for double Atlantic crossing in 1952.*

S/L. J. ZURAKOWSKI (CF-100): *Senior development pilot, Avro Canada. Began flying in 1935. When Poland invaded, joined R.A.F. Destroyed six e/a. E.T.P.S. in 1944 then A. and A.E.E. Joined Glosters in 1947. Avro Canada in 1952.*

G. LYNES (CF-100): *Canadian who learned to fly at 15; joined R.A.F. as fighter pilot; taken prisoner; escaped. After war was C.F.E. pilot. Flight-tested Sabres and T-33s at Montreal before joining Avro Canada.*

J. W. WILSON (D.H. 110): *D.H. assistant chief test pilot. Joined R.A.F. in 1942; flying instructor, 1943–44; Tactical Air Force, Far East, 1945; Central Fighter Establishment 1947–48. Joined de Havillands in 1948.*

J. ELLIOT (D.H. 110): *Chief test pilot at D.H. Christchurch factory since January, 1954. Royal Navy 1941–1954. Won McKenna Trophy at E.T.P.S. 1948. With R.A.E. 1949–1952. On active service Korea, and instructor at E.T.P.S.*

Who's the Pilot?

IT IS customary in the S.B.A.C. flying display to keep the pièce de resistance until the end of the programme. This year it may fairly be said that there is more than one pièce ; but even so the English Electric P.1—which, unfortunately, is expected to appear on only the first three days—is perhaps the most eagerly awaited. Forming a climax to the programme with the P.1 is the remarkable F.D.2 delta research aircraft; and, a little before this, the diminutive and shapely Gnat. Portraits of their pilots appear on this page. Two test pilots not shown here may take over the controls of important aircraft on one or more of the days. They are G/C. R. G. Slade, F.D.2, in place of P. Twiss, and S/L. L. M. Whittington in place of S/L. E. A. Tennant in the Gnat.

F/L. J. W. ALLAM (Victor): *Handley Page test pilot since 1954. Joined the R.A.F.V.R. in 1942. No. 9 course at E.T.P.S., and No. 5 Course Test Pilot Training Division, U.S. Navy, 1950. "B" Squadron, Boscombe Down, from 1951 to 1953.*

G. R. BRYCE (Valiant): *V-A. chief test pilot (Weybridge Works) since July, 1951. In Fighter, Coastal and Transport Commands during war. After service as a Viking pilot in the King's Flight, joined Vickers-Armstrongs in 1946. Has more than 5,000 hours.*

E. B. TRUBSHAW (Valiant): *V-A. deputy chief test pilot (Weybridge Works) since 1950. Pilot with King's Flight from August, 1946 to December, 1948. On staff of Empire Flying School 1949 and later on staff of R.A.F. Flying College, Manby, Lincolnshire.*

W/C. R. J. FALK (Vulcan): *Avro superintendent of flying. Flew in Abyssinia during the 1935–36 war, and in Spain 1936. A.R.B. test pilot 1938–39. Served with R.A.F. 1939–46; was chief test pilot at Farnborough beginning of 1943. Has flown 7,000 hours on 300 types.*

S/L. C. C. CALDER (Vulcan): *Bomber Command liaison officer with A. V. Roe. With Bomber Command throughout war. Commanded No. 158 Sqn.; posted to No. 37 Sqn. Middle East in 1945. In 1947–50, M.U. test pilot. In 1950–52, Air Ministry staff.*

S/L. J. G. HARRISON (Vulcan): *Joined R.A.F. in 1935. Served with No. 605 Sqn. and later on air staff of 64 Group Northern Reserve at York. At E.T.P.S. course in 1949 was runner-up for McKenna Trophy. In 1952 completed course at R.A.F. Staff College.*

S/L. E. A. TENNANT (Gnat): *Folland's chief test pilot. Flew Defiants and Typhoons with No. 257 Sqn., completing some 250 sorties by end of war. After war was at E.T.P.S. and Boscombe Down. Joined Follands in June, 1953. Has flown nearly a hundred types.*

S/L. N. DUKE (Hunter): *With Hawkers since 1948; chief test pilot since 1951. In war destroyed 28 e/a. R.A.F. High Speed Flight, 1946; E.T.P.S., 1946; Boscombe Down, 1947–48. World record of 727.6 m.p.h. on September 7th, 1953.*

P. BULLEN (Hunter 6): *Flew Spitfires and Mustangs in Fighter Command during war; joined Blackburns as a test pilot in 1946 and Hawkers in 1949. Is now their chief production test pilot. He has 4,000 flying hours.*

LT.-CDR. M. J. LITHGOW (Swift F.R.5): *Joined R.N. 1938, then Boscombe Down test pilot. Naval test pilot British Air Commission, U.S.A., 1944–45. Joined Vickers Supermarine; now chief test pilot. Several records, including 735.7 m.p.h. in Swift F.4.*

D. W. MORGAN (Swift F.R.5): *Joined R.A.F.V.R. 1942, transferred to Fleet Air Arm 1944. Left R.N. in 1950 to join Vickers Supermarine. Established London–Brussels record in Swift at 665 m.p.h. in 1952. Is qualified helicopter pilot.*

F/L. L. R. COLQUHOUN (Swift F.R.5): *Senior production test pilot, Supermarine Works. Joined R.A.F. in 1940; served in U.K. and Malta as a P.R. Spitfire pilot. Seconded to Vickers as test pilot in 1945; joined firm on demobilization in 1946.*

W/C. R. F. MARTIN (Javelin): *Gloster chief test pilot. In France in 73 Sqn. (awarded D.F.C.); fighters, M.E.A.F., 1941–44; Transport Command in India-China 1945. After E.T.P.S., R.A.E. flight commander; later E.T.P.S. instructor. Has 3,600 hours on 150 types.*

P. VARLEY (Javelin): *Gloster assistant chief test pilot. Joined Glasgow U.A.S. in 1941. Flew Beaufighters and Mosquitos with 89 Sqn. in Far East 1945. At Boscombe Down in 1953 before joining Glosters in 1955; 2,600 hours, 58 types.*

F/O. G. WORRALL (Javelin): *Gloster chief production test pilot. Served in R.A.F. 1940–46 and with No. 616 Sqn., R.Aux.A.F., 1947–51. Joined Glosters 1950. Has over 2,000 hours on 21 types.*

F/L. B. SMITH (Javelin): *Gloster development and production test pilot. In R.A.F. from 1942–46. Spitfires and Vampires with 501 Sqn., R.Aux.A.F., 1947–51. Has been with Glosters 4½ years. Over 2,000 hours on 22 types.*

P. TWISS (F.D.2): *Fairey test pilot since 1946. Joined Fleet Air Arm 1939; night fighter interception unit; British Air Commission U.S.A. for Naval night fighter evaluation. E.T.P.S. course in 1945, then Naval Squadron at Boscombe Down.*

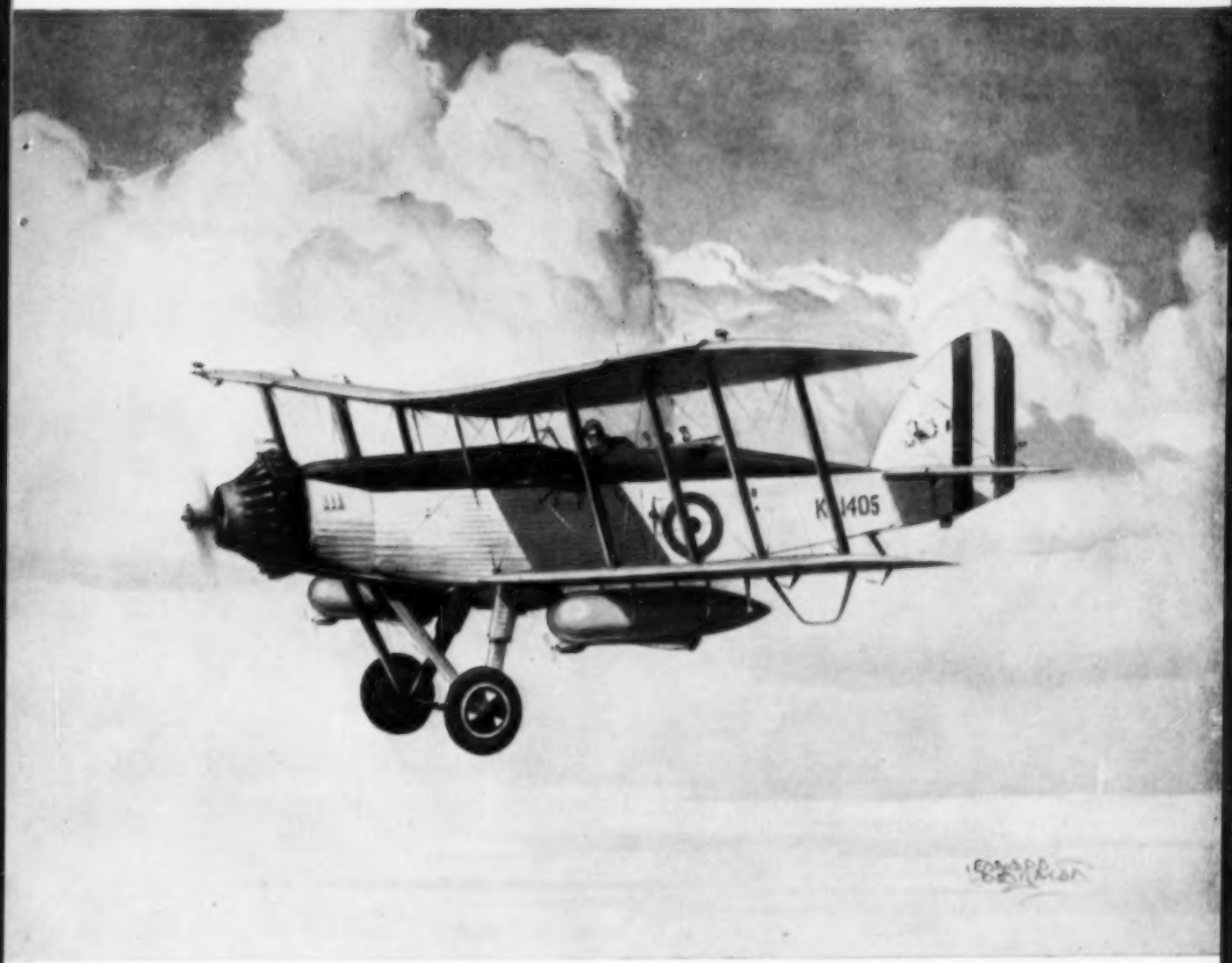
H. C. ROGERS (Conway-Ashton): *Rolls-Royce assistant chief test pilot. R.A.F. apprentice in 1938. Bomber Command, D.F.C. and Bar. Transferred to Transport Command. In 1946 became C.F.I. at Nottingham Flying Club; in 1948 joined Rolls-Royce as a test pilot.*

A. J. HEYWORTH (Conway-Ashton): *Rolls-Royce chief test pilot. Served in Bomber Command and completed two tours of operations with No. 22 Squadron. D.F.C. and Bar. Posted to Rolls-Royce in 1944 and remained with company on demobilization.*

J. D. BAKER (Shackleton): *Joined R.A.F. in 1941; daylight bombing in T.A.F. Tested aircraft at Boscombe Down, flying-boats at Felixstowe from 1944–48, then to Avros at Shackleton test pilot. Piloted the first Avro-built Canberra in 1952.*

LT.-CDR. J. G. P. MORTON (Gyrodyne): *Entered Navy 1943, commissioned 1944; after varied F.A.A. flying duties, recent appointments have been with No. 705 Helicopter Sqn., with A. and A.E.E., and in H.M.S. "Centaur." On loan from Navy to Fairey.*

AS IT WAS . . .



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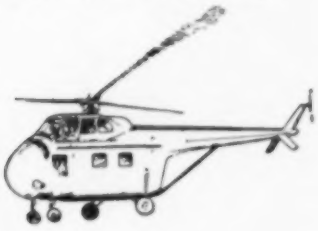

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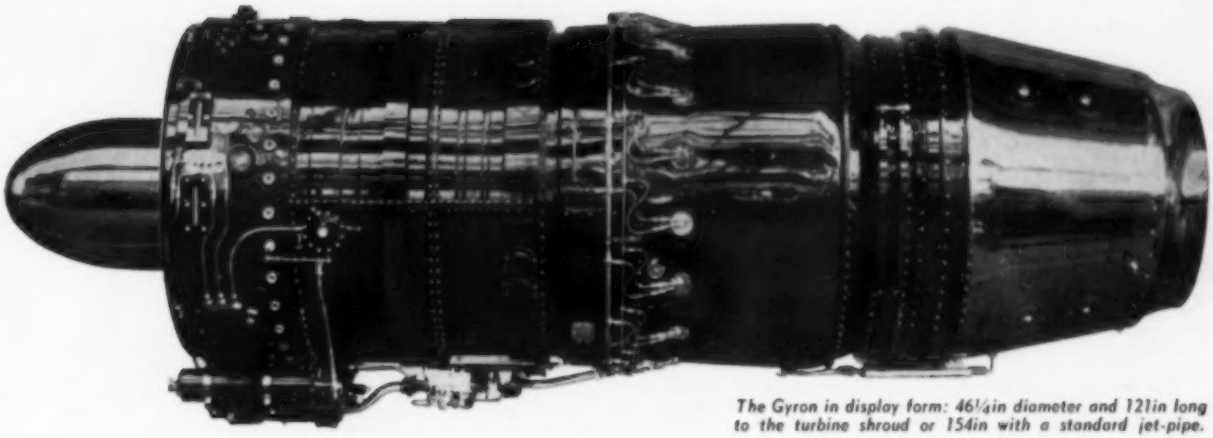


The Gyron in display form: 46¼in diameter and 121in long to the turbine shroud or 154in with a standard jet-pipe.

TOMORROW'S ENGINES

—*at the Farnborough Show*

BY THE TECHNICAL EDITOR

ALTHOUGH it would be neither fair nor accurate to describe this year's S.B.A.C. Exhibition as an "engine Farnborough," the fact remains that it is the occasion for the first public showing of British powerplants of the utmost significance and consequence. As always, these engines cannot be fully described at their first showing; details of their mechanical design are allowed to be discussed only where they are externally evident, and practically no performance figures may yet be published. Nevertheless, we have prepared the following discussion in order that something of the background of these most important units may be placed in true perspective.

On a number of counts the de Havilland **Gyron** deserves to head the list. As is already known, this engine is a large turbojet designed particularly for supersonic flight.

As we mentioned last week, it is now eight years since the de Havilland Engine Co. were able to display a new gas turbine. During most of this time the company's engine designers, under the direction of the late Major Frank Halford, were looking sufficiently far ahead to enable them to by-pass the entire stage of development represented by present axial engines and concentrate upon something that would mark as great an advance as did the introduction of the turbojet itself. It was, in fact, five years ago that the company's thoughts crystallized into the design of a turbojet suitable for supersonic applications; and by "supersonic" de Havillands intended to go the whole hog and reach a really worthwhile Mach number and not something of the order of 1.2 or 1.3.

It was obvious from the outset that a great deal of thrust was going to be needed. It was also obvious that the whole programme was going to break a lot of completely fresh ground. Accordingly, in the basic formulation of design parameters for the new turbojet—which, incidentally, was originally designated Halford H.4—the de Havilland Aircraft and Engine companies joined forces. The Aircraft company conducted research into various "paper" fighter designs, and kept the Engine company informed of probable thrust requirements. During 1950, therefore, the H.4 design became progressively more clearly defined, until eventually it was possible to issue drawings for the manufacture of prototype parts.

It must be remembered that in 1950-1951 supersonic flying was completely unknown in this country, and the de Havilland Engine Company had to base their original design of engine on ideas which were sometimes conflicting and frequently ill-determined. From the outset, however, it was evident that the Gyron would have to be an entirely new sort of engine and not just a bigger axial of the Avon-Olympus-Sapphire type. At high supersonic Mach numbers it is possible to utilize the kinetic head of the intake air to do a greater proportion of the compression; for example, at 1,500 m.p.h. the ram pressure ratio (isentropic) can be as much as 7.5 : 1 at sea level and 12 : 1 at the tropopause.

As a result, it is possible to relieve the engine compressor of a proportional amount of work, thus making it possible to dispense with a number of compressor stages and making the whole engine significantly shorter, more compact, more rigid and much lighter. It was soon proved to de Havilland's satisfaction that a medium-compression engine of this nature would have an exceedingly competitive specific weight coupled with a low specific fuel consumption at high supersonic speeds and altitudes.

Between 1950 and 1952, the company conducted a considerable amount of research, much of the actual testing being on a scale hitherto unknown in this country. Various applications were considered for various types of Gyron, with and without an afterburner and with and without a supplementary rocket motor. As a result of this work, the de Havilland Enterprise now seem to have supersonic formulæ completely "buttoned up." Nevertheless, they wished to prove the rightness of their thinking before offering the Gyron for sale, and the engine was accordingly only put forward to the Ministry of Supply after prototypes had been made and successfully run. The engine then received Government backing and it has since been developed under M.o.S. contract.

It can now be stated that the Gyron has been fully type-tested at a rating of 15,000 lb thrust; and it is patently obvious that this is a conservative figure even for the engine as it exists at present. The establishment of such a rating at this stage is a certain indication that the Gyron will be capable of type-approval at 20,000 lb thrust without exceeding present established limits of turbine inlet temperature, and it is likely that the de Havilland Engine Company can see considerably higher values than this on the horizon.

It is a fundamental precept that one of the principal factors governing the power that can be obtained from a given size of engine is the turbine-inlet temperature. This temperature, which today is normally less than 1,250 deg K, is obtained partly by compressing the air and partly by the burning of fuel in the combustion chamber. In the past, the need for good specific fuel consumption has led to the employment of compressors of high-pressure ratio (up to 13 : 1) which raise the temperature of the air by more than 250 deg C. At Mach numbers now envisaged the ram compression alone can raise the intake air temperature from 0 to 200 deg C, so that the delivery at the downstream end of the compressor may have a temperature as high as 500 deg C, leaving under 500 deg C available for the combustion of fuel. Speaking generally, thrust is proportional to the rate at which fuel is burned and it is therefore highly desirable to increase the maximum rate at which fuel can be injected without overheating the turbine. In the Gyron, the reduced pressure ratio must leave at least another 100 deg C available for the combustion of fuel so that the engine can produce proportionately higher thrust at supersonic speed. In such engines, therefore, high pressure ratio is no longer an advantage, and the new philosophy is to make ram compression do the work.

Subsonically, of course, the Gyron cannot equal the s.f.c. of high-pressure engines like the Olympus and J57. On the other hand, its efficiency is considerably better than that of centrifugal turbojets and must correspond roughly to that established by the early axials—which, incidentally, required a larger number of compressor stages to achieve the same result.

No weight has been revealed for the Gyron, but it has been stated that it is an exceptionally light engine for its thrust. This is a remarkable fact when it is borne in mind that almost the entire structure must be of steel (or, perhaps, in later versions of the engine, alloys of titanium) in order to obtain the required

TOMORROW'S ENGINES . . .

structural strength and rigidity at the required pressures and temperatures set up by flight at around twice the speed of sound. It is extremely doubtful, however, that the present Gyron is intended to fly at such Mach numbers at low altitudes—if it were it could not possibly be described as a lightweight engine—for the penalty of increasing the bursting strength of the compressor and combustion chamber casings to meet the enormous internal pressures of such operation is exceedingly large.

It will be observed that the diameter of the Gyron is only 10 to 15 per cent greater than that of engines of half the thrust. Clearly, the increase in output is out of all proportion to the increase in size and it is part of the de Havilland formula to be able to swallow far more air per unit of frontal area than is usually possible. To achieve this aim a very great deal of research work into blade and compressor design has been undertaken and combustion research must also have loomed large in the development of this engine.

Walking around the present Gyron one is struck by the relatively small size of the unit. The shape is reminiscent of a boiler, the compressor having no taper on its outer diameter. As a result, the addition of essential accessories inescapably increases the overall envelope size of the engine, but this is far less of a disadvantage than might be supposed. In a fuselage, for example, there is invariably room for the accommodation of the extra six inches or so which these accessories require, and even in a pod the optimum shape of fairing between the intake and the propelling nozzle would more than suffice to accommodate all the appendages that could be needed.

Installation is, of course, a weighty problem in any supersonic turbojet. Intake efficiency is all-important; for example, an increase in intake efficiency of three or four per cent can increase the installed thrust by as much as could be obtained by raising the turbine-inlet temperature by 30 deg C or more, and the latter could not be achieved without overcoming immense problems.

This insistence upon turbine entry temperature underlines the importance of work done by the Mond Nickel Co. and Henry Wiggin in developing improved turbine-blade materials. Nimonic 100, announced two weeks ago, itself permits approximately 30 deg C increase in maximum operating temperature, although these new alloys have problems of their own. The same company also revealed some of their developments in the manufacture of air-cooled turbine blades at the S.B.A.C. show in 1954 and it is known that such blading is employed in some of our latest turboprops. It is emphasized, however, that this discussion on new blade materials and design is not intended to refer to the Gyron, the interior of which is secret and will remain so for a considerable period.

In his lecture *Powerplants for Supersonic Flight*, read in Los Angeles this summer, Dr. E. S. Moult, chief engineer of the de Havilland Engine Co., outlined some of the problems of supersonic turbine design and pointed out that, owing to greatly increased mass flow, turbine blades in engines like the Gyron had to be longer, and consequently suffered increased stresses at the roots. He also emphasized that most blade-cooling schemes increased the stress compared with that in an uncooled blade, so that the cooling had to reduce the metal temperature below that already employed if a satisfactory strength margin was to be maintained. With a cooled blade, said Dr. Moult, it was tempting to thicken the trailing-edge and root to ease the stresses and provide satisfactory passage for the cooling air; but turbine efficiency was so vital to overall performance that few liberties could be taken in this direction.

He went on to point out that, in supersonic flight, the temperature of air tapped from the delivery of the compressor would be considerably greater than in subsonic engines and that, in consequence, increased temperatures had to be accepted on the hot components which are at present cooled by such air. Turbine discs, in particular, were likely to get hotter owing to this, and other, factors. The cooling of bearings, particularly the rear bearing, also posed considerable problems.

Most of the external features of the Gyron are clearly shown in the heading photograph, among these being the sub-division of the compressor casing into four parts, each portion having circumferential strengthening ribs. Behind the compressor is the usual diffuser section, surrounding which are two fuel galleries, one of which is a main supply and the other a secondary supply to duplex-type burners. There are seen to be 17 of the latter evenly disposed around the circumference of the combustion section. The latter is certain to be either of the cannular or truly annular type, and has a curious outer profile. Behind the combustion chamber is the turbine section and jet-pipe, the diameter of which emphasizes the huge mass flow. The surface of the engine is notably devoid of pipes, cables and ducting.

An oil sight-glass can be seen at the front end, on the port side. Curiously, there seems to be no sign of a fuel pump, neither is a starter visible, although a number of other conventional accessories are mounted on the underside of the compressor casing. It is likely that the starter, at least, is mounted directly on the nose, under the large bullet fairing. Incidentally, de Havilland are this year exhibiting a peroxide starter—an entirely new development—although it is too early to couple it with the Gyron. Nevertheless, if the Gyron conforms to present rules for fighter engines, it is stressed to take a turbine starter.

At high supersonic Mach numbers an afterburner can provide as much as 100 per cent increase in thrust, and it is likely that reheat developments for the Gyron are already in hand. Supersonic afterburners pose notoriously difficult design problems, involving as they do convergent/divergent propelling nozzles of variable area (there was considerable discussion of the factors involved at the recent Anglo-American Conference in Los Angeles following the paper by Dr. E. S. Moult already referred to).

One of the fundamental variables facing the designer of a supersonic fighter is whether he should use a large engine with a convergent/divergent nozzle without afterburner or a small turbojet with afterburner or, as a third alternative, two small turbojets. Future fighters are likely to cost approximately £1m each and the view of the fighting Services is likely to be that two engines are always better than one, particularly in so expensive an aircraft. De Havillands have therefore backed the horse both ways by developing the **Gyron Junior** which, if one can make deductions from names, is probably a direct scaled-down facsimile of the Gyron. This engine is now running, but no details of its size or performance may be published. Much will be heard of it.

Considerable prominence has already been given to the provision of mixed power for supersonic flight. The combination of a turbojet and rocket can be shown to offer unparalleled advantages in providing high rate of climb, rapid acceleration to high supersonic speeds and enormously enhanced performance at altitudes of the order of 60,000ft or more. For this purpose the de Havilland Engine Co. have developed the **Spectre,** a new liquid-fuel rocket which is already being teamed with the Gyron in a number of projected aircraft. No details whatever may be published regarding the Spectre, but it is certain to have a greater thrust than the 4,000 lb produced by the Super Sprite a.t.o. motor. Supposing that a fighter were fitted with a Gyron giving 20,000 lb thrust; at 60,000ft this figure would fall to less than 5,000 lb at full power and it is likely that the Spectre will be able to produce considerably more than this.

It is also worth noting that the Gyron-formula engine should be able to achieve an overall fuel consumption at high supersonic speed and altitude just as good as that at present achieved by present axials at lower altitude and in subsonic flight. Thus the way is opened for a host of long-range applications for an engine basically similar to the present Gyron.

One of the most important facts of all is that the Gyron has already been running for more than two years and has now been type-tested (the first such test having been finished on August 15th). On the other hand, there are no airframes at present available for it and it is exceedingly doubtful if there will be any until about 1960. Thus, for the first time in history, developed engines of an entirely new type will be ready and waiting to take prototypes into the air.

Derby By-pass

Attention is now turned to Derby, where Rolls-Royce have developed an engine which is equally significant and even better in economy, although it is intended for a completely different regime of flight. This engine is the **Conway** by-pass turbojet.

In a by-pass engine, compound (otherwise known as split or two-spool) compression is employed, each compressor being driven by its own, mechanically independent, turbine. In this respect, the Conway resembles the Olympus or J57. Unlike any previous engine, however, the blades of the low-pressure compressor are made exceedingly long, so that all the flow through the outer part of this compressor can be by-passed around the smaller high-pressure compressor and combustion chamber, to re-enter the main stream immediately downstream of the turbines. In last week's issue we published a diagram showing the manner in which this is done. The cool by-pass air surrounds the hot central jet and in a long jet pipe there must be a considerable degree of mixing between the two flows.

As a result, the total mass flow through the engine is very much greater than that through a conventional turbojet burning fuel at the same rate. The designer can, of course, choose any by-pass ratio he likes; he can by-pass one per cent of the total intake flow, in which case the engine is virtually a turbojet, or he can by-pass 80 or 90 per cent, in which case the engine can be thought of as a turboprop with a ducted airscrew.

By-passing part of the air alters all the characteristics of the engine as an aircraft powerplant. In comparison with a simple turbojet burning fuel at the same rate, a by-pass engine has the following characteristics: a greater total throughput of air; lower mean jet velocity, and hence higher propulsive (Froude) efficiency; greater diameter, and almost certainly greater weight; and lower noise level. The increased propulsive efficiency can be shown to permit the use of higher cycle temperatures than in a conventional

turbojet, and this in itself results in improved thermodynamics for the flow put through the combustion chamber and turbines.

It has been shown (by Mr. A. A. Lombard, chief engineer of the Aero Division of Rolls-Royce, in a recent paper) that it is possible to choose an established turbojet and scale it up or down until the various components are suitable to form the basis of the high-pressure section of a by-pass engine. A low-pressure compressor and by-pass duct can then be added to complete the new powerplant. Naturally enough, Rolls-Royce have not revealed how much late-model Avon there is inside the Conway, but it is fair to assume that many of the principal portions of the two engines are dimensionally similar, the only differences being in scale (Reynolds number) and in detail engineering.

It is possible, therefore, to make direct comparison between the by-pass engine and the simple turbojet. Rolls-Royce have done this, assuming equal component efficiencies, similar design assumptions and identical applications. Several methods of comparison are available. In Mr. Lombard's view the best method is probably to design both engines for equal take-off thrust at the same maximum turbine-inlet temperature, so that both turbines operate under the same thermodynamic and stress conditions.

If this is done, the altitude performance (550 m.p.h. at 40,000ft) can be compared at the same thrust, combustion temperature or specific fuel consumption. For example, at the same combustion temperature (1,040 deg K), the ratio by-pass/simple turbojet will be: thrust, 0.925; s.f.c., 0.93; and the effective increase in aircraft range, five per cent. At the same thrust, the by-pass will have a combustion temperature of 995 deg, resulting in 0.995 of the turbojet s.f.c. and giving 4.5 per cent range increase. With equal s.f.c., the by-pass will give 1.33 times as much thrust at 885 deg K, resulting in six per cent more range.

Thus one can expect to gain about five per cent in range by using a Conway in preference to the nearest equivalent simple turbojet. Installation problems, also, are eased, owing to the fact that the outside casing of a Conway should never get hotter than about 100 deg C, or up to 150 deg C after a tropical take-off. Although anti-fire precautions cannot be ignored, this great reduction in skin temperature makes possible the saving of a considerable weight in fireproof bulkheads, and fire-suppression systems, and also largely eliminates the need for a large flow of cool air required to ventilate and cool the engine bay.

On the other hand—for one rarely gets something for nothing in aviation—the Conway turns the scales considerably more firmly than does an Avon, and it is also more complicated. To try to bury a Conway would seem futile, yet Vickers Armstrongs have done it—admittedly in the biggest production-type aircraft yet built outside the U.S.A.—and have made a very neat job of it. Nevertheless, the V.1000 installation must inevitably have caused the Weybridge designers headaches in their attempts at evolving an economic spar structure. In a pod, of course, the Conway causes no trouble at all; in fact Mr. Lombard has called the pod "God's gift to the by-pass engine." He went on to say that it was not necessarily a gift to the by-pass aircraft.

In the Vickers 1000 series the Conway is to be used in just the flight-regime for which it is best fitted: Mach 0.85, or thereabouts, at high altitude, for hours on end. At lower speeds the airscrew takes over, with its higher take-off thrust and better all-round efficiency, and at higher speeds the turbojet is supreme. Nevertheless, a case can be made for the use of a by-pass turbojet engineered into a fighter, with an enormous degree of reheat made possible by the presence of the by-passed flow of pure air. It might, for example, be possible to develop a Conway giving well over 30,000 lb thrust with the maximum degree of afterburning.

The present Conway is, at least, now properly hammered into shape, and the successful completion of a full type test is a very creditable achievement. Beyond the thrust selected no details of performance may yet be published. Rolls-Royce do, however, state that the s.f.c. achieved was better than that for any other type-tested turbojet—as it certainly ought to be. Just how much better is one of the good things which we must look forward to knowing, and which is at present making the engine so attractive to transport designers on the other side of the Atlantic.

Having "walked round" the Gyron, it is appropriate to inspect the Conway. The first impression one receives is that the Conway is really quite slim; and, in fact, it is—incredibly so. It has an intake diameter of 39.9in and the maximum girth over the by-pass duct is only 41½in—no more than the diameter of an Avon. For comparison, the length (in the form exhibited, and illustrated here) is 129in.

The front of the Conway consists of a giant intake, the critical surfaces of which are de-iced by hot air brought round on the starboard side and controlled by a Teddington electric gate valve (the duct is visible in the photograph on p. 398 last week). There are 41 massive entry guide vanes, the hub/tip ratio of the low-pressure section being very low. Next can be seen the casing over the l-p compressor, split into top and bottom halves, aft of which is a diffuser casing bearing two integral mounting trunnions. These trunnions take all the thrust and weight of the engine, the only other attachment being a steady at the top of the turbine casing.

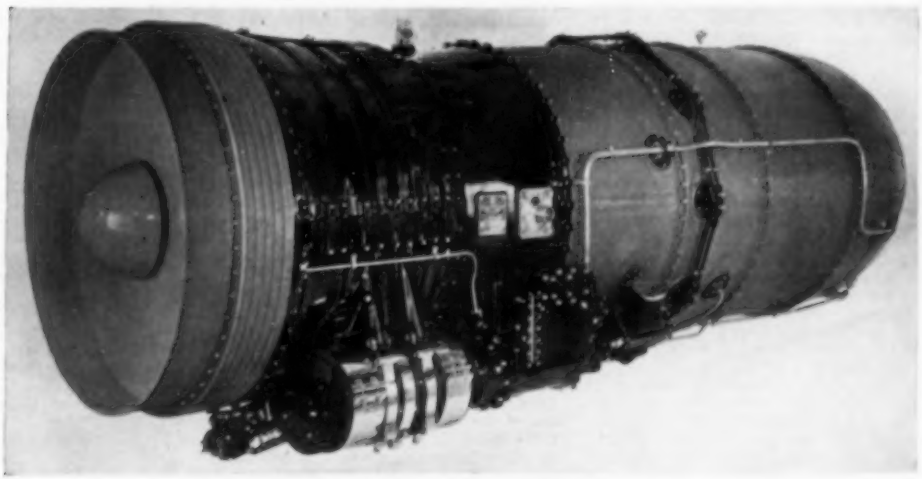
In last week's illustration, already referred to, the black ribbed box mounted low on the starboard side of the intake is the oil cooler (clearly fuel-cooled). Next behind is the silver-finished fuel-control unit (Lucas) and the B.T.H. igniters. There are rigid fuel lines to the 10 Lucas duplex burners, and one high-energy igniter is mounted on each side of the combustion chamber. The latter is evidently of the cannular or annular type. On the port side, shown here, are the Rotax electric starter, the drive to the tacho-generator and, underneath the engine on the front flange of the wheelcase, the fuel pump. Also on the port side are an oil sight-glass and an oil-pressure transmitter.

Napier's Contribution

Some further details are now available of the Napier E.151 **Eland** (NEl.3 rating) which has been developed for the Fairey Rotodyne helicopter. The power requirements of this aircraft are unusual, although not unique. At take off, all the power from the two Elands is absorbed by auxiliary air compressors which supply air to tip-burning rotor jets. In full forward flight, all power is transmitted to propulsive airscrews. In hovering flight, differential airscrew thrust is required to provide control in yaw, although the airscrews normally remain in zero-pitch, or that for minimum power absorption, when there is no forward speed.

As far back as the three-stage turbine the E.151 is very nearly a standard Eland of the type fully described in our issue of July 23rd, 1954. Aft of this point is a tubular extension to the main rotor shaft, which drives a fluid clutch. When empty of oil this clutch has 100-per-cent slip, and hence does not drive; when filled it has an exceedingly low slip and provides an almost direct drive to a nine-stage auxiliary compressor mounted at the rear of the main power section.

In order to accommodate this compressor, the exhaust outlet



Port side view of the exhibition Conway, showing the electric starter, tachometer drive, fuel pump and oil sight glass. Remarkably, the Conway is no fatter than an Avon turbojet.

TOMORROW'S ENGINES . . .

from the turbine is bifurcated port and starboard, and the clutch and auxiliary compressor are then able to nestle up against the rear of the turbine, from which they are protected by a heat-shield. The compressor itself is quite conventional, having light-alloy discs and aluminium-bronze blading (D.T.D.197A) as used in most Napier engines. The pressure ratio is about 4.2:1, a considerably higher value than that employed in the Oryx gas producer (described in our issue of August 5th, 1955), emphasizing the fact that the Rotodyne will have tip-burning, whereas the Hunting Percival P.74 will employ a low-pressure gas system with pressure jets at the rotor tips.

In the design of the Sinclair-type fluid clutch D. Napier and Son, Ltd., co-operated with Fluidrive, Ltd. Generally speaking, the latter company made themselves responsible for the design of the basic hydraulics of the coupling, while Napiers evolved the mechanical design and solved cooling and installational problems.

At the NEl.3 rating, the clutch has to transmit a maximum of over 2,200 s.h.p. at 12,500 r.p.m. Both the power and the speed are very high and certainly the transmission of such power at such speed has not previously been done through such a clutch. In the design of the clutch, diameter was one of the most critical factors. In essence, the clutch becomes a whirling bag of fluid, and centrifugal force becomes overwhelmingly important at high r.p.m., tending to burst the clutch casing. This imposes a restriction on diameter; but the high r.p.m. makes a large diameter unnecessary. In the event, a double-bucket (tandem) layout was adopted, resulting in a saving of about 15 per cent in diameter—not a great amount but sufficient greatly to ease design problems and reduce the bursting hoop-stress to a reasonable amount.

This reduction in clutch diameter made it easier to accommodate the drive between the bifurcated jet pipes. On the other hand, the small diameter increased the problems of heat-dissipation. Had the clutch had a diameter of two or three feet these would have been minor, but the present design has very limited surface area. Oil cooling has, therefore, been adopted both for the running and for the fanning (no-load) condition. The waste heat to be removed is, by chance, almost exactly the same in each condition of running.

The clutch is housed in a self-contained casing. The drive from the turbine is taken through a sophisticated type of gear coupling and passes to a continuously rotating outer case hanging in two bearings, one ball and one roller. As the sketch shows, this case carries the forward row of buckets for the front clutch and the rear row of the rear clutch. Within this case is supported the secondary shaft, in a ball bearing at the forward end and in a plain bearing at the rear, the latter permitting the oil flow to be brought into the clutch.

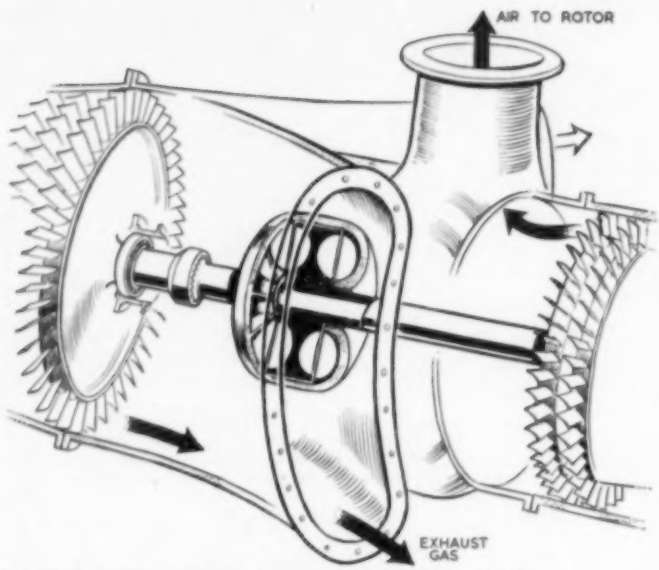
This oil flow totals approximately 350 gal/hr, and is drawn from the main engine supply and pressurized by a special clutch pump. As long as the clutch is filled the oil drains away at this rate through bleeds; to evacuate the clutch, and so discontinue the drive, the oil feed is shut off, and the clutch then empties in a few seconds.

In the Fairey Rotodyne an E.151 Eland is mounted, completely underslung, under each wing. Air for the auxiliary compressor is taken in through louvres in the rear of the nacelle, compressed and then passed through a diffuser section, single-exit (upwards) volute and delivery duct along the wing and up into the rotor. The airscrew is a four-blade 13ft Rotol (larger than that used in the NEl.1), fitted with c.s.u., feathering and reversing. The airscrew is always driven. For starting, the Eland is turned over normally, with the airscrew in minimum-power pitch and the fluid clutches empty, i.e. fanning. For take-off, the clutches are supplied with oil and the full airflow passed up to the rotor from both Elands, and the tip-jets ignited. At the appropriate height and forward speed, the auxiliary compressors are de-coupled and the airscrew pitch increased to that appropriate for cruising flight. Lift is provided by the autorotating rotor and the fixed wing.

In cruising flight a quite considerable airflow is induced through the rotor by centrifugal force, and the passage of this is enough to cause the auxiliary compressors to spin gently. This has the advantage of avoiding "Brinelling" of the bearings.

Full details of the control system of the fixed-wing Eland have yet to be cleared for publication, and the same can certainly be said of the E.151. It can be seen that it is highly desirable to be able to control rotor mass flow at any given engine speed in order to have a rapid control over rotor power. Another point worth noting is that, whereas in cruising flight the airscrews are under the control of the c.s.u., in the hovering case they have to be under direct manual control from the cockpit in order to provide the required degree of stability and control in yaw.

The E.151 has already completed a considerable amount of bench running, including a special-category test. The engine has been run at all design powers on a dynamometer, with the clutch brought in and out as required, and has also been run without load on the airscrew shaft with the coupling again being operated.



A simple diagram of the rear portion of an E.151 Eland. The drive from the turbine, through the fluid clutch, to the auxiliary compressor is evident. The bifurcated jet pipe and the air delivery to the rotor are also shown.

During these tests the control system has held the engine on speed despite the large changes of load when the coupling is operated.

Reverting to fixed-wing Elands, it is now clear that the introduction of air-cooled turbine rotor blading has made possible the attainment of powers far greater than one might expect from a change in turbine design. On the other hand, it is most important to note that the Napier designers allowed for a great increase in power from the outset (far more than was then anticipated), and the amount of redesign that has been needed to accommodate the increased ratings is exceptionally small—in fact, it is almost completely confined to the installation of the new turbine blades with their associated air supply.

Ratings of these Elands were published in our British Aircraft Industry issue last week (p. 407), and it can be said that results so far obtained on test are most encouraging. In fact, the NEl.5 is unlikely to represent the ultimate that can be obtained.

Of the **Oryx** there is little new to add beyond that contained in last week's issue, and in the full description referred to earlier. There is, however, the wholly new **Gazelle**, first announced only a week or so ago. This is, at NG.1 rating, a shaft-drive engine with a rating of 1,260 s.h.p. It has now been announced that it is to power a Bristol twin-rotor helicopter (presumably a military machine). In such an aircraft there are several possible ways of installing such an engine, but it is always desirable to keep the free-turbine drive as close as possible to the reduction gearbox and rotor hub. One solution, of course, is to stand the Gazelle on end, with its intake drawing in air through ventral louvres. Alternatively, the slim units could be installed lying along the top of the fuselage. In either event, their use will make possible a very great saving in space and weight, in comparison with any equivalent piston engine. It should, for example, be possible, in a helicopter like the Bristol 191, to provide a gangway past the engines, irrespective of which method of installation is adopted.

A free-turbine drive is, of course, particularly advantageous in a helicopter, for it confers great flexibility and can render a clutch unnecessary. On the other hand, it can be of value to a fixed-wing installation, and time will show whether or not the Gazelle will find non-helicopter applications. Its size is right for several purposes, and it has no competitor, apart from the less powerful Twin Turmo and, in the U.S.A., the General Electric T58 and the Lycoming T53 and T55.

So much for the completely new engines which have been cleared for public display at this year's S.B.A.C. Show. Mention should also be made of other units which, although not new, have not previously been exhibited in Britain. Among these are Armstrong Siddeley's Sapphire 7, now rated at 10,500 lb thrust, Bristol's Olympus 101 and Orpheus, and the de Havilland Gipsy Major 200. These engines were, however, displayed at the Paris *Salon* earlier this year. More notes on British engines will be published next week.

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PROFIT IN PERSPECTIVE

A Critical Survey of B.E.A.'s Report

By ROBERT J. BLACKBURN

AS in previous years, the annual report of British European Airways for 1954-55 is in many ways a model of its kind. From its 70-odd pages, packed with facts and stiff with statistics, it is possible to build up an unusually complete picture of the technical, economic and organizational state of the airline.

The result can be encouraging or disturbing, depending on one's viewpoint. Even though it represents less than a penny gained for every pound spent, the £63,000 profit earned by the Corporation in 1954-55 marks a vast improvement on the previous year's £1¼ million loss. As the report points out, the profit is not a "flash in the pan," and there should be no looking back on the long, dreary era of deficits.

Comparison with its own past, however, is not the only yardstick of an airline's progress. Measured against the standards of economy and productivity set by large airlines in North America and Australia, the results appear less satisfactory. The following figures compare some B.E.A. figures from the 1954-55 report with corresponding results achieved by two North American carriers in the calendar year 1954.

	B.E.A.	T.C.A.	American Airlines
Number of employees ...	9,112	7,991	16,300
Revenue ton-miles flown (× 1m)	63.6	102.3	417
Revenue ton-miles per employee (× 1,000)	6.99	12.80	25.59
Total wages (£m)	6.75	11.00	32.19
Salary per employee (£) ...	740	1,376	1,997
Revenue per revenue ton-mile flown (pence) ...	62.6	56	43

The immediate implication of these figures is that B.E.A.'s staff is far too large or, alternatively, that their productivity is far too low. Assuming that the airline's fleet is reasonably well suited to its route structure—which is now broadly true in B.E.A.'s case—the productivity of its staff is the most important single factor influencing economy of operation, because salaries and associated costs represent the largest item in the budget.

Any inferences drawn from these comparative figures must be qualified in the light of local conditions. B.E.A.'s particular short-haul and seasonal problems are more severe than those encountered by any other airline of comparable size. For this reason it is certain that B.E.A. could never achieve better economy than the American domestic trunklines, as typified by American Airlines. At the same time, it would be dangerously complacent to assume that B.E.A.'s comparatively poor results (commercially speaking) are due solely to geographical, commercial and political factors beyond the airline's control.

A Europe-America Comparison

It could be argued that to some extent B.E.A.'s short-haul problems are partly offset by relatively cheap labour, lack of air competition on domestic routes and of rail competition on international routes, and high revenue rates. Not the least significant of the figures quoted in the table above are those showing the difference between European and North American revenues per ton-mile. The strict budgetary control which makes possible the low American rates—and in turn, creates the incentive for every-day, nation-wide use of air transport—is all too easily taken for granted. Since European air fares are 50 to 100 per cent higher than in North America, and average earnings are lower, it should be apparent that this incentive is lacking in Europe, where air travel can still be classed as a luxury product rather than a public utility.

Tourist fares, introduced to intra-European routes in 1953 with nervous misgivings, were a step in the right direction, but their effect has been largely cancelled out by half-heartedness on the part of airlines in applying the cheaper-fares policy and by Government-imposed passenger charges, adding to the already excessive burden of fuel taxes and landing fees.

B.E.A.'s share in the formulation of I.A.T.A. policy on European fares is not easily determinable, since rates are fixed in secret session by unanimous agreement of all the airlines concerned. The Corporation's public pronouncements on the subject, however, have revealed a remarkable lack of continuity in its commercial policy. In 1953 the airline declared its whole-hearted belief in the then-new fares policy. In 1954 it complained that the reduced rate of earning on European routes, brought about "by international agreement," was partly responsible for the £1¼m deficit. This year's report says that the tourist-fares policy "appears to have been one of the major factors in laying the foundation for economic success in 1954-55 and the future," explaining that its long-term benefits "could not be clearly determined" in 1954.

The Corporation's hazy approach to commercial matters contrasts with its forward-thinking technical policy, which was largely responsible for bringing the Viscount to its present peak of success. Can it be hoped that B.E.A., with an increasingly large fleet of Viscounts, will pioneer a new era of cheaper, more frequent intra-European services? It is certainly logical to expect B.E.A. to dominate the European scene, because, apart from its superiority in equipment, the Corporation is the only major European airline concerned primarily with regional operations. Lack of commercial initiative on the part of its competitors is understandable, because they derive the bulk of their revenue from long-haul services.

Unfortunately, the contents of the current B.E.A. report suggest that the Corporation would not be justified in seeking to attract new traffic by lowering its rates, or in urging other I.A.T.A. carriers to do likewise. Canadian and Australian experience so far shows that the Viscount's economics live up to all expectations, but the B.E.A. Viscount fleet appears weighed down with overheads and is at present incapable of earning sufficient profits to balance losses incurred on other types. B.E.A. aircraft operating results for 1954-55 were as follows; Viscount profit, £713,665; Elizabethan loss, £304,272; Viking loss, £329,594; Pionair (DC-3) loss, £511,641; Islander (Rapide) loss, £53,742; Heron loss, £1,058. Chartered aircraft yielded a small profit of £2,838. Total traffic revenue earned by all types amounted to £16,594,461 against total costs of £17,078,275. The resulting £483,814 deficit was offset by non-operating revenues of £546,853 (notably "commissions"—presumably on interline ticket sales—which brought in £438,953), resulting in the net profit of £63,039.

Elizabethan and Viscount Costs

On the basis of these figures, B.E.A.'s operations cannot yet be regarded as economically sound. Replacing Elizabethans with Viscounts (even if this were possible), would not produce any significant improvement, since the Elizabethan is stated to give slightly better costs than the Viscount over distances of up to 410 miles on international routes. The loss incurred on Elizabethans resulted, apparently, from their use on short sectors (averaging 299 miles, compared with the Viscounts' average of 484 miles). Nor, it seems, would replacement of Pionairs with Viscounts or Elizabethans improve matters, since the Pionair's average stage is 155 miles, and the B.E.A. Pionair is credited with lower seat-mile costs than either of the newer types on distances *of up to 500 miles*.

These figures suggest that while B.E.A. have proved the technical merit of the Viscount, they are not yet capable of exploiting to the full its commercial characteristics. An appendix to the report, dealing with aircraft type costs, gives the Viscount's total cost per revenue flying hour as £186.2. This is perhaps 50 per cent more than the equivalent figure for an "average" Convair 340 in U.S. domestic service and about equal to the figure for an "average" DC-6B. Purchase of the Viscount by T.C.A. and Capital Airlines for short-haul service in North America indicates that the aircraft is fully capable of matching or bettering piston-engined economy. Capital Airlines, whose average stage-length is only 239 miles, hope to achieve a break-even load factor of 50.6 per cent with their Viscounts, whereas the corresponding B.E.A. figure is 59.6 per cent.

The higher fuel costs and landing charges paid by B.E.A. must be partly to blame for the disparity, but these two items together accounted for only 12 per cent of total Viscount costs in the period covered by the report.

Depreciation rates are certainly not responsible for a major share of operating costs; the report shows that Viscounts and Elizabethans are being written off over a period of ten years instead of the more usual seven.

The apparently high cost of the B.E.A. Viscount is undoubtedly attributable in part to low utilization of both aircraft and crews. In 1954-55 the average revenue utilization of B.E.A. Viscounts was 1,724 hr, or 4.7 hr per day. Captains and first officers in B.E.A. averaged 548 hr each over the same period; for radio officers the figure was 488 hr. In considering these figures, the operating problems particular to B.E.A. must be taken into account; even so, it is difficult to believe that there is no room for improvement.

In setting out aircraft operating costs, the report makes use of a B.E.A. formula which, though no doubt efficient and convenient from an internal viewpoint, does not facilitate comparison with figures published in other sources of reference. So far as one can determine, however, it does appear that engineering and other

(*Concluded at foot of page 463*)

ROTOR-BLADE MANUFACTURE

A Specialist Art Described in the Helicopter Association's Opening 1955-56 Lecture

AN instructive exposition of a highly specialized subject —the manufacture of rotor blades—was provided by a paper due to be delivered last night before the Helicopter Association as the first lecture of the new season. The authors were Messrs. R. Allen Price and Frank L. Stulen, of the Parsons Corporation, Traverse City, Michigan, and the paper was being read by Mr. Price. Below are summarized a number of passages from the lecture, the full title of which was *Design, Development, Production and Servicing of Rotor Blades*.

The paper began by outlining some of the primary requirements in a rotor blade. A blade weighing only 50 lb might have to support 1,000 lb of airframe and to withstand 30,000 lb of centrifugal force. With tip speeds of over 700 m.p.h. and blade loading averaging 50 lb/sq ft, it was as highly loaded as a high-subsonic-speed aircraft wing. In addition, there was the need for extreme accuracy in weight and balance—as, for example, weight tolerances of about half of one per cent and a balance point located within 0.020in of a specified location on a blade of perhaps 30 sq ft surface area. Above all these requirements was the essential stipulation that no catastrophic failure could be tolerated.

Passing on to design considerations, the lecturer briefly reviewed orthodox methods, saying that by far the greatest quantity of blades employed standard symmetrical sections because of their beneficial c.p. travel characteristics. During the past 20 years blades had been fabricated principally from wood—sometimes solid, with woods of various densities to maintain proper chordwise and spanwise balance. Some blades had structures similar to those of wings.

Latterly there had been persistent effort to employ all-metal structures, thus avoiding the liability to changes in weight and shape which were a characteristic of wooden blades exposed to moisture. This, however, had brought the new problem of designing such materials as steel and aluminium into a structure which would prove reliable under the fluctuating stress imposed during the life of a rotor blade. Early troubles arising from the use of riveted light alloy structures had been overcome with the advent of metal-to-metal adhesives, first used by the lecturer's company ten years ago.

Going on to describe test methods employed by Parsons Corporation, the lecturer said that there was constant testing of materials, adhesives and detail parts to establish sound values for use in the design analysis. With any new blade design the firm fabricated from ten to 20 "partial blades" with which to conduct static and fatigue tests. A test method extensively used by his company was a modification of the Marcel Prot method. It mainly involved running the specimen at some alternating stress level below the endurance limit for a chosen number of cycles. The stress was then increased by a small increment and the testing continued for the same number of cycles. The procedure was repeated, using the same stress and cycle increment until failure occurred.

Comparison of tests conducted at the Propeller Laboratory, at various research institutions, and by the author's own laboratories had shown that the Prot type test resulted in a satisfactory approximation of the endurance limit scatter indicated by the S-N type test. Which method, if either, provided the real endurance limit was, of course, open to question.

For these tests, spars were taken in the as-fabricated condition, complete with surface blemishes caused by handling, corrosion, etc. The test values were indicative of spars that had received the worst possible treatment rather than of those represented by polished laboratory test specimens. All data resulting from the tests were accounted for in the final statistical evaluation. The dangerous practice of deleting a low value as an "isolated occurrence" might lead to a failure in flight which was also an "isolated occurrence" but which, unfortunately, could not be so conveniently "deleted."

Having accumulated fatigue data by statistical methods, one was faced with the problem of establishing the design fatigue stress allowable. This required the determination of an acceptable probability level, which in turn could be determined by studying existing rule-of-thumb safety factors and the probabilities of survival of groups of ordinary people subjected to ordinary hazards. Existing safety factors seemed to indicate a choice of operating stresses which corresponded to a 10,000 : 1 probability level for the brazed spar. The odds of survival in any group of 25-year-old males dying from ordinary causes were 100,000 : 1.

Since the plus or minus 14,000 lb/sq in value at a level of $P = 0.9999$ for the brazed spar was to be used as the endurance limit, and since it was not probable that all blades would be subjected to this stress for their total life of 10^7 cycles, it was obvious that the actual probability of survival of the spar was considerably greater than 10,000 : 1.

Specimens were also tested in the more conventional manner to provide an S-N curve for comparison with the Prot test data.

While bench, whirl and flight testing each contributed a tremendous amount of valuable information, no one test was sufficient in itself—there were many actual case-histories to prove that a blade which had satisfactorily proved to be serviceable on bench tests and which had accumulated hundreds of hours on a whirl tower (even with well-simulated loadings) might fail miserably in experimental flight test—or, worse still, might develop serious difficulties in actual service.

Assuming now that the design had been confirmed, and substantiated by certain static and fatigue tests, and that a set of blades had been produced which were presumably adequate at least for experimental flight, the remaining unknown was the accuracy of the stresses calculated from theoretical loads; these, of course, were readily obtained from flight strain-gauge recordings.

The lecturer went on to underline the danger of reducing design margins of safety for any particular type of application; there was perpetually some newcomer who had dreamed-up for an old design an entirely new use which might violate the original design concepts. Quoting the Bell-47 as already having had nine years of active production history, the lecturer said that the blade designer now had to budget for a production life of ten years; this might include provision for increases in s.h.p. of perhaps 30-50 per cent, changes of aircraft gross weight of about 25 per cent, and perhaps for alterations of rotor diameter by the changing of tip sections or some similar method.

Going on to quote other figures, the lecturer said that Helicopter Air Services in Chicago had been carrying mail for five years; their six original machines were all still in service with average flight time over 6,000 hours each. Two sets of blades had accumulated over 4,000 hours and four of them had accumulated over 3,500 hours; their other blades had accumulated over 2,000 hours. Several of their original rotor blade sets were still operating and they had never retired a set of blades with less than 4,000 hours' service. With success such as this, it was obvious that it cost less per flight hour to write-off main rotor blades than it did to write-off tail rotors, instruments, engines, etc.

Passing on to the subject of manufacturing costs, the lecturer spoke of the difficulties of judging whether (a) to have elaborate tooling which would permit inexpensive production of large quantities of blades, but which might have to be scrapped in the event of a design modification, or (b) to retain simpler tooling which, however, might raise production cost if large quantities had, after all, to be manufactured. Dealing briefly with costing techniques, he illustrated one of his points by a slide showing the ten-thousandth blade of one type made in his company's shops—"the largest quantity in history."

Discussing in the final section of their paper the service life of blades, the authors emphasized that there was much wear and tear apart from that which occurred when a helicopter was airborne. This aspect they underlined in their paper in the following words:—

"This blade with all its spit and polish now goes into service. Neither the chief design engineer, the chief manufacturing inspector, nor the resident plant inspector are around to rant and rave about the mechanics who drop a blade on the 'boiler plate' flight deck while rushing to meet an emergency. Nor are they present to stop the operator who naturally wants to continue his crop dusting after banging the blade tip against a hangar door and marring the tip structure. After a few hours of hovering over sand and gravel, the 10 micro-inch finish is no longer recognizable on that part for which it was specified in order to increase its laboratory endurance limit above measured flight stresses. These conditions are only normal wear and tear and must be accounted for in design. Obviously, when it is in use, the blade will wear out.

"Certainly we all recognize the need for normal wear and tear designing and most of us are attempting to achieve such designs. We recently discussed some new blade requirements with a helicopter manufacturer, who insisted that we keep our design compatible with his philosophy, which expects an endurance limit of only plus or minus 8,000 lb/sq in on a 150,000 lb/sq in heat-treated steel fitting with moderate built-in stress concentrations. To some, this may sound like poor engineering; to us it shows good common sense, because this part will undoubtedly be subjected to hard wear and tear and its failure can mean loss of life."

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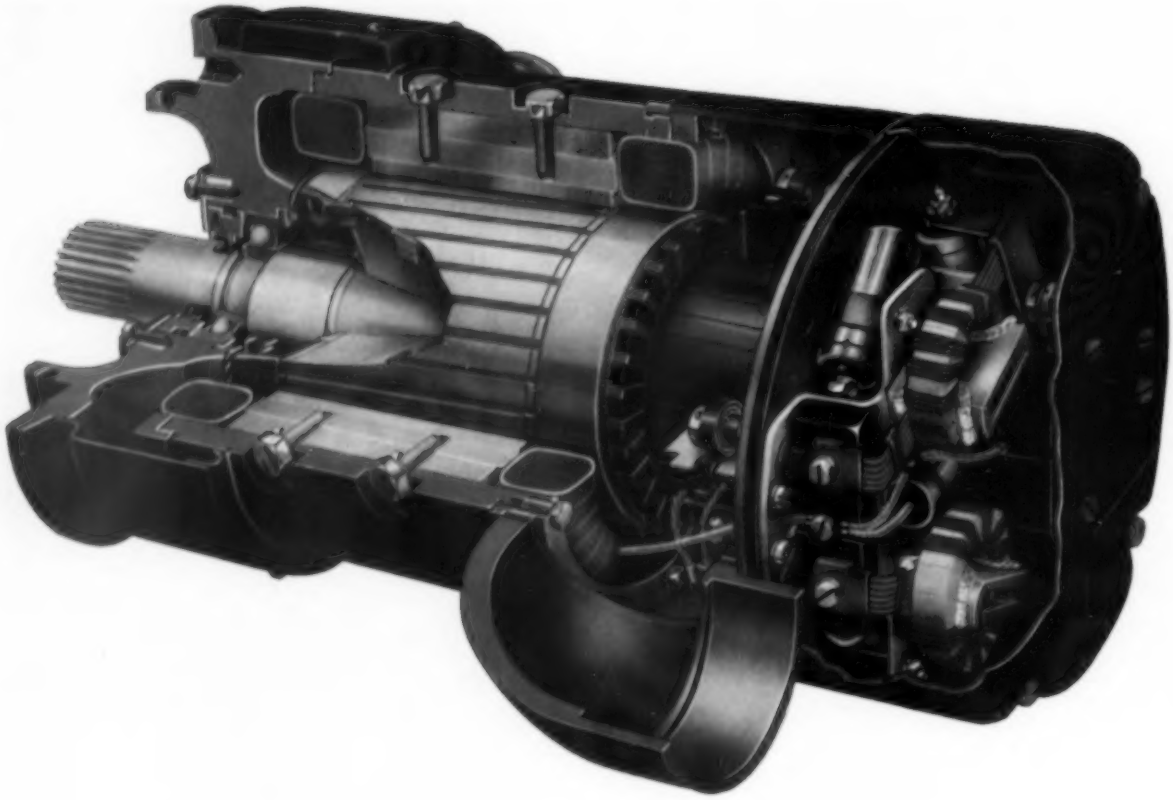

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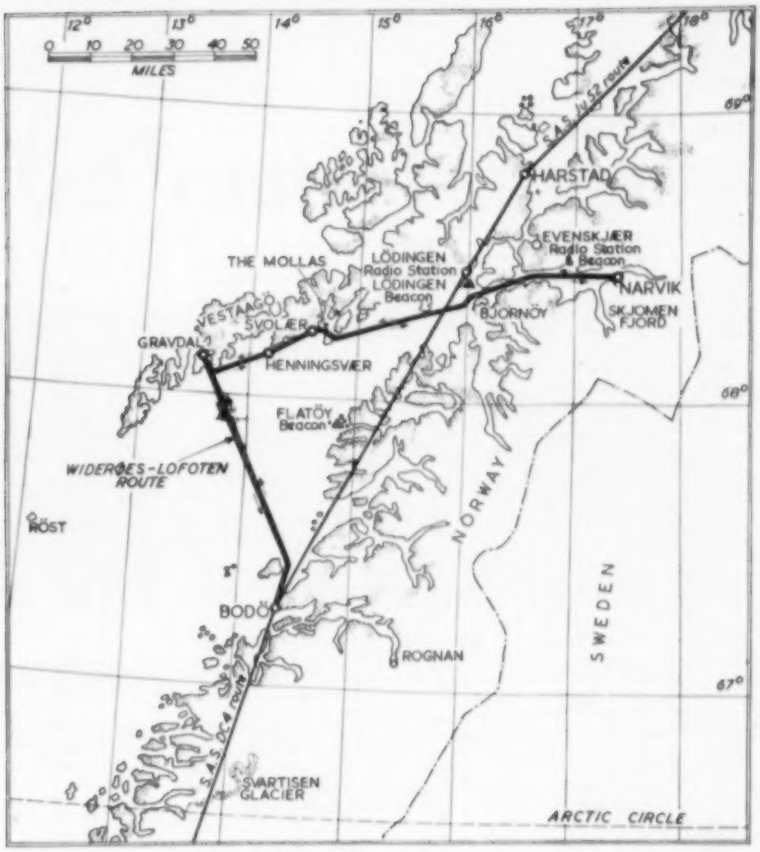
THE LOFOTEN ROUTE

Flying on One of the World's More Remote Airlines

By

C. B. H. BARFORD



IN Norway, the name Widerøe spells aviation. Two brothers of this name started the first civil flying company twenty-two years ago, using a Tiger Moth on floats and a pair of Wacos, with which they gave joy-rides and flying instruction. By the late thirties, three Stinson Reliants, a Bellanca and chartered Ju 34 had been added, and these were employed in aerial surveying, taxi-work, and on the first scheduled passenger run, to Haugesund on the west coast.

It was in a Reliant that one of the brothers lost his life when a wing gave way in the year 1936, but the other, Viggo, carried on; and in spite of a complete stoppage during five years of German occupation, he has built up a very active business. After the war, land and sea communications were naturally in a bad state, and the small floatplane became tremendously useful. It does not need much knowledge of Norway's terrain, with its tumbled mountains, its lakes, twisting fjords and myriad islands, to realize that such aircraft are particularly suitable hereabouts. Widerøe acquired some Noorduyn Norsemen on floats, Fairchild Argus, Me 108s, and a couple of North American Seabee amphibians; and for a while he operated three Cub Coupés which somehow had been hidden away during the Occupation.

At the present time the fleet includes one Cub, a Cornell, a Luscombe, and two Cessnas, which are used in air-taxi work and for target-towing for the forces. There are three Oxfords for aerial survey and for newspaper runs to Kristiansund and Stavanger. A Seabee is kept in Trondheim for ambulance and taxi service. Five Norsemen and a de Havilland Canada Otter on floats are used in the far North for ambulance work and for scheduled runs. One of these services is from Tromsö, *via* several stopping points, to Kirkenes on the Russian border, and the other goes from Narvik to Bodö *via* the Lofoten Islands. Both connect with S.A.S. lines from Oslo.

The company's main base is at Oslo's Fornebu airport, where the tiny radio-less Luscombe seems to mingle happily in the circuit with S.A.S.'s DC-6Bs and B.E.A.'s Viscounts.

On a Scandinavian flying trip last year I had fallen for the fascination of Norway's North, and particularly of the Lofoten Islands, whose weird peaks, seen afar off standing straight up from the sea, have been likened to a disordered row of dog's teeth; so I did not hesitate when Mr. K. Friis-Baastad, Widerøe's

(Left) S.A.S. terminal buildings at Bodö. Mr. J. Erensen, apprentice pilot of Wideroes, stands in the entrance. (Right) Airport staff (plus one taxi-driver) and terminal buildings at Narvik.

THE LOFOTEN ROUTE . . .

chief pilot, wrote one day and said, "You can come and fly for a few days as second pilot in our Otter on the Lofoten route."

Three times a week in summer S.A.S. run a special service from Oslo to Bodö for tourists to see the midnight sun, and on this I travelled. The aeroplane, a comfortably furnished DC-4, leaves at 8.40 p.m., and arrives just before midnight. Visitors have until 3.30 a.m. to go for a tour, have dinner, buy souvenirs, and admire the sun. They are deposited back at Fornebu at 6.45. It was nobody's fault that on this occasion the clouds completely obscured the sun, but certainly the S.A.S. captain made great efforts to give the customers their money's worth. He went well out to the west, and climbed to 14,500ft, to try to break through the clouds. The crew sucked oxygen from hookah-like mouthpieces, the passengers panted a little, but it was to no avail.

The cabin staff did well, too. One steward and one stewardess fed and cosseted 55 people with much care, and kept on coming round with more beer "on the house" and coffee, and handed out souvenir "Crossing the Arctic Circle" certificates. Half an hour before reaching Bodö the aeroplane dipped gently, and the captain announced over the public-address system that we were now over the Circle.

A thin cold rain greeted the travellers to Bodö. The crew went off to fish, and the visitors departed to do their stuff. I went to bed in the town's imposing Grand Hotel.

However, the weather was not so bad next day—though who can speak of "day" when it is daylight all night, people are about at all hours, and you eat and sleep when you feel like it? Soon after eleven o'clock a neat light green seaplane creamed down into Bodö inner harbour, and taxied up to a red buoy. This was the Otter. Out of it a quite incredible number of people poured (eleven passengers, to be precise), and the pilot handed out after them mounds of baggage, mail and freight. It is a good thing the machine has such a large capacity, for each passenger has a free baggage allowance of 44 lb to correspond with that allowed on S.A.S.'s connecting service. The payload of the Otter, with minimum safe fuel on board, stands at the high figure of 2,200 lb.

The pilot, forewarned of the arrival of his new "assistant," introduced himself as Trygve Rydland. As the departure for the North was not due till 3 p.m., there was plenty of time over a late breakfast to learn something about the route. The normal schedule is:—

0830		d. Narvik	▲	a. 1735
0920		a. Svolvær		d. 1645
0935		d. ,,		a. 1630
1000		a. Gravdal		d. 1605
1010		d. ,,		a. 1550
1105	▼	a. Bodö		d. 1500

Svolvær is the capital of the Lofotens, and has about 4,000 inhabitants. Gravdal, although only a scattered fishing village itself, is a convenient collecting centre on the rather inaccessible island of Vestvaag, where about 14,000 live. The schedule has to be flexible; and today, as there was to be an unusual number of passengers from Gravdal, we should have to go first to Svolvær, back to Gravdal, once more to Svolvær, and at last home to Narvik.

The route is open from the beginning of February to the end of October, at which time the daylight becomes too short. This, and the winter weather, make it impossible to keep the whole route open all the year, but many people believe that a direct Narvik-Bodö line could be run with fair regularity. The service is subsidized, however, and it may be that the government would not consider the expense justified in mid-winter. The terrain makes regular night-flying impracticable, but some ambulance trips have to be made in the dark. Fortunately the coast is well provided with lighthouses, and fishermen can be briefed to line-up a couple of boats into wind as a guide to landing. The air trip, though costing more than the sea journey, is invaluable for people who want to do a few hours' business or to see a medical specialist in Bodö (doctors are few in the "off-islands"). The steamer times are worth comparing with the schedule above: Narvik-Svolvær, nine hours; Svolvær-Bodö, six; Narvik-Bodö, eleven. For Gravdal they are even less convenient.

Flying on this line, where the weather can change very quickly from clear skies and light winds to low cloud, fog or rain and a choppy sea, requires a good deal of route-experience. Indeed (as Rydland explained), before operating scheduled services here a pilot must not only satisfy his chief pilot of his competency, but must also be checked-out by an inspector from the Directorate of Civil Aviation. (M.T.C.A., please do *not* note; we have enough problems already in Britain with route-experience requirements for airline pilots!)

Looking back over the final approach path, Svolvær. The "Goat's Horns" can be seen halfway up the left side of the mountain.

Time passed quickly. Rydland had several errands to perform: shopping for an acquaintance in Svolvær, being stopped by an old lady in the street with a last-minute message for a relative in Gravdal. A pilot on this route is a quick link between people many miles apart and is soon known to everybody as a willing purveyor.

At 2.30 p.m. we watched the departure of one of S.A.S.'s Ju 52s on floats, bound for Harstad and Tromsö. This machine, with its three engines and corrugated surfaces, looked, in comparison with the sleek Otter, every bit of its eighteen years; but it does its job very safely and efficiently.

All Widerøe's handling is done by S.A.S., in a small hut down on the quay among the fishing boats and coasting steamers. The fact that the regulations do not require the separate weighing of passengers, even for a machine of the Otter's relatively small size, brings a blessed simplicity to departure formalities. From the hut the pilot can telephone the aerodrome met. office for the latest reports from his destinations and obtain a general picture of the weather situation. There is no tedious filing of a flight plan; he just gives his flight details by V.H.F. to Bodö Control when airborne.

We piled into a motor boat with ten passengers and their luggage, a large number of bulky cartons of fresh flowers just in from Oslo, and sacks of mail. It all looked a great deal for the Otter's one engine to pull, but this impression was soon forgotten when Rydland opened up, and Pratt and Whitney's 600 h.p., after an astonishingly short run, lifted the machine effortlessly over the mole protecting the inner harbour. He set

The D.H. Canada Otter taxies out for take-off from Hammerfest Harbour.

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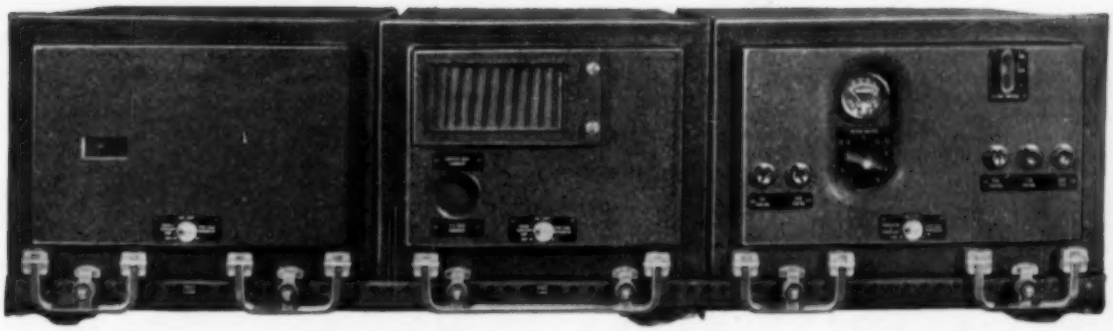

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THE LOFOTEN ROUTE . . .

course due North over a grey sea capped with white flakes, and levelled off at 800ft. All flying hereabouts has to be contact, for precipitous mountains rise up to nearly 5,000ft, and there are no aids for letting down through cloud except at Bodö's airport, which has G.C.A. There are, however, some useful non-directional beacons along the route, and the aircraft's neat A.D.F. set was soon tuned to the Flatöy beacon, which sits on an islet almost on the direct track to Svolvær. Skerries lay scattered below, and to the right the mountains rose up above Maaloy to disappear in cloud at a thousand feet. From the left a veil of rain drove in, and soon the visibility was down to 2,000 yd. This is quite normal; in fact, the company's official minimum is one kilometre, while a judgment of safe cloud-base is left to the pilot. By putting down some flap, and flying at 90 m.p.h. from one rocky island or from one sea-mark to another, a perfectly safe track can be maintained.

The Otter has a throw-over control column, and Rydland handed this over until the end of the flight. The aeroplane flies very easily, and can be trimmed to fly hands-off for appreciable periods. Confronting the occupant of the right-hand seat are the A.D.F. and the H.F. transmitter controls, and a few odd things like cockpit-heating switches. In the centre of the instrument panel are the engine instruments, fuel gauge, etc., all lavishly and usefully picked-out in the usual transatlantic red, green, blue and yellow paint marks. In front of the pilot is a standard British blind-flying panel. The radio gear includes a six-channel V.H.F. set. The view over the nose is extremely good, and the cockpit is roomy (fortunate, this, because sometimes mail had to be stuffed in between and under our seats). Indeed, the only complaint one could make was at the absence of windscreen wipers, because the obscuring of the screen by rain was a definite drawback in marginal weather conditions; but perhaps the slight curve of the Perspex makes the fitting of wipers impracticable.

For a few minutes after leaving the skerries we flew out of sight of land, but soon the visibility improved to perhaps two miles, and there ahead lay the first sight of the Lofotens, a large hump called Skraava Island, followed by Greater Molla isle, which rises straight up to nearly 2,000ft. Now we could see only the lower quarter of it, for the cloud-base had suddenly come down, and skirting it to our right at 300ft we fetched round a rocky bay to approach Svolvær harbour for landing. On base leg we left on the right a red and grey rampart of rock growing straight up from the sea on the town's outskirts. Half-way up this mountain at about a thousand feet there stand out two rugged rock turrets called the Goat's Horns. If you wish, you can climb up to these and leap the several feet from one to the other; meanwhile, the town band will play a "Dead March" for you below. People do it sometimes, mostly those of the race that in other climes goes out in the midday sun.

Svolvær, like Venice, is built partly on a series of islands, but these are bare granite outcrops, and they surround a small enclosed harbour. Houses, canning factories, ships and jetties crowd around it so closely that not until you are on short final can you see any place to land; then suddenly you are lined up with a clear space in the harbour, and the Otter glides down, with a slight cushioning burst of power, to settle in to a smooth landing.

So this is the capital of the Lofoten Islands. There is silence, except for a seagull's cry. The slight smell of codfish drying on huge racks surrounding the town is wafted through the cockpit window. Fish, of course, is the mainstay of life here, and great quantities are exported. A fine rain is still falling, and the sky is heavily grey, but in spite of this the houses are pleasant to look on, for they vary in colour from dark red to green, yellow, brown and grey, with windows and doors picked out in white. A large white stone church stands out in contrast to the background of beetling mountains. It is very convenient to land in the middle of a town like this: passengers report at the quay a few minutes before scheduled departure time, or more likely when they hear the sound of an approaching engine, and are aboard and airborne within ten minutes.

A chugging announces the approach of the patrol boat which for the last ten minutes has been keeping the harbour clear of shipping and removing any flotsam that could be dangerous, and it is lashed to the Otter's port float. There are no passenger-shepherds, loaders or ship's-papers officials on this route. The pilot jumps out of the cockpit, lifts mail, children, and pieces of freight into the boat, and assists the joining passengers up the steep ladder into the Otter's cabin. He signs a receipt for more mail, gets back into his seat, shouts a promise to deliver some messages in Bodö at lunch-time, and starts the engine. This has all taken five or ten minutes, and meanwhile the boat has brought the seaplane back to the down-wind end of the harbour. Within a minute the machine is rushing past the jetties and fishing boats to make another phenomenal take-off, and is on course for Gravdal.

Here began perhaps the most awe-inspiring part of the trip, as we coast-crawled south-west along the Lofotens. All the superlatives of modern cinema would not do justice to the wild scenery, and the fact that the mountains, as we peered up at them, disappeared into cloud just above our own level gave them a curiously mystic air. It was not hard here to understand legends of wild mountain trolls and the worship of fierce gods such as Thor and Odin. One fantastic shape sped past another as the machine bumped along in the air-eddies set up by the tall mountains. Occasionally there would be a tiny red homestead clinging to the rocky shore. Deep chasms wound a way into the mist on the one side, and the rain clouds merged with the horizon on the West Fjord on the other.

We passed over the astonishing town of Henningsvær; this is built on an archipelago of rocks, joined together by narrow wooden footbridges and causeways, and some buildings are set on stilts over the sea. It lies a couple of miles off the mainland, and, given the need for a town hereabouts, it stands on the only possible site. There just is no flat land for miles around. A few minutes' flying now, out of sight of land across the mouth of the Gimroy straight, brought us to more tortured landscape, round a high cape, and into the long bay at the head of which Gravdal lies. It was a flight of only twenty minutes, but it was "packed with breath-taking thrills."

The mountains here are withdrawn a little, and the approaches are fairly free from gusts; but this is a mixed blessing, for clouds can sweep in unobstructed from the West, whereas Svolvær is to some extent protected by the mountains which surround it on three sides. Gravdal is just a sprinkling of houses watched over by a handsome red and white church built of wood in the traditional Norwegian *stavkirke* style.

The Otter taxied up to a raft in the bay, and the procedure was much as before, though this time the machine needed refuelling. On this route, where high payloads are always offered, it is worth flying around with the minimum safe fuel, and spending an extra ten minutes or so filling up at out-stations. By cruising at 26 Hg and 1,800 r.p.m. (which gives a speed of 115-120 m.p.h.) fuel consumption can be kept down to 35 gal/hr; a "low fuel" warning light gives ten minutes' notice before a tank runs out. The Otter has three tanks, which have sensibly been placed in the belly for easy access; but it is still an awkward task for one harbourmaster to hold the heavy five-gallon jerricans over an unwieldy filter-funnel while he stands on the aeroplane's float bucking on the choppy water.

The Otter was facing into wind, at the up-wind end of the bay, when it was released from the raft. Before starting-up Rydland let it drift towards the other end, explaining that, because of the Otter's relatively large tail, it is difficult to turn it out of wind when there is a good breeze blowing. Then we careered back to

THE LOFOTEN ROUTE . . .

Svolvær, waving to tiny fishing vessels bucking before a heavy swell.

We took off for Narvik at 5.30 p.m., and at 700ft headed east for the mile-wide gap between Little Molla and her sister Great Molla. The air was now fairly smooth, and I was gazing idly down at some neat farmsteads on the shore, when the aeroplane gave a series of violent lurches. Rydland smiled at my alarm and said this always happened here because of the peculiar shape and proximity of the two island-mountains. A very beautiful stretch of landscape followed. The mountains stood back, and the undulating coastal strip broke away into thousands of islets, each one edged in a flashing white ring of foam. The larger ones held neat houses, some with a tiny lush meadow of emerald green, running down to a small beach of startling white sand. Rocks were covered in brown and yellow lichen, and here and there a patch of deep red seaweed had been washed up.

It was by one of these islands that Rydland made a precautionary landing last year when the weather unexpectedly closed in before and behind him. He and his six passengers were put up at the nearby house for the night, and the next morning went happily on their way. This, let it be added, is not a common experience in Widerøe's operations. Indeed, they keep up a remarkable regularity in face of great weather and terrain difficulties, and last year the schedule was cancelled only once.

The A.D.F. needle sidled round to the left as we passed Lödingen beacon and entered Ofot Fjord, near the head of which Narvik stands. Just before the town, a slight detour to the right took us to peer down at the rusting remains of the destroyer *Kelly* at the mouth of Skjomen Fjord, reminder of an epic naval battle fifteen years ago. We crossed the town, which lies at the foot of a 4,000ft mountain, glimpsing the cemetery of the Allied forces who landed here in 1940; flew into the narrow Beisfjord, which forms the southern side of the peninsula on which Narvik lies; made a tight turn of 180 degrees; and landed beside a harbour full of iron-ore ships. The place seemed rather sombre that evening, overshadowed by steep fells whose dark sides were relieved only by the occasional silver thread of a falling stream.

The airport boasts a floating jetty, a hut which houses a waiting room, a radio repair section, and an engineer's living quarters. The staff consists of two happy engineers and an energetic man who seems to do everything that is needed, including the driving of the patrol boat with which he clears the harbour before take-offs and landings. A local travel agent looks after the passenger bookings, ticketing, etc. A substantial new hangar is provided with a winch for hauling the aeroplane up from the harbour, and it affords facilities for carrying out major maintenance.

The pilot's work is nominally over by six o'clock, but he is always on call for ambulance flight. This may mean going, at a moment's notice, anywhere from the remote archipelago of Röst, a hundred miles away off the southern tip of the Lofotens, to a small lake up in the mountains by the Swedish frontier. Last season these calls averaged two a week, and they had to be fitted in on top of the 4½ hours' daily scheduled flying.

This may seem a short day's work, but it takes no account of the manifold calls on a pilot's time and energy outside his actual flying. The telephone rings often in his hotel room: a call from Oslo to discuss maintenance questions; one from Widerøe's base at Tromsö to say they are sending a Norseman in to Narvik tomorrow on a charter trip; an agitated mother, having missed the steamer, wanting to know if there is a spare seat to Gravdal in the morning. The day starts at 7.30 with telephone calls to Bodö, Svolvær and Gravdal, to discuss the weather.

I flew four days on this route, and on each one the elements provided new surprises. This is a part of the world where many of the North Atlantic depressions end their days, piling up one on another, and there are no reporting stations west of the Lofotens to give the forecaster much idea of what is on the way.

The only landing place on this route that has radio is Bodö, and frequent use is made of the government stations which ring the coasts of Norway. The ones on this route are at Evensjær and Lödingen, and their operators are very quick at telephoning

Röst Archipelago off the south-west extremity of the Lofoten Islands. Private aerial photography is forbidden in Norway, and this is an official one taken by Widerøe's.

Gravdal and Svolvær for immediate weather reports. It was interesting to note that Norwegian pilots and operators address one another in English, sticking strictly to the Alpha Bravo alphabet. The only time Norwegian was used was in talking over the V.H.F. to the *patrullje bot* before landing.

One hazard of aviation is absent from this route, that of running into other aircraft, because practically no one else operates here; but the Otter makes frequent position reports all the same, abeam of places with such difficult names as Kjeöy, Bjornöy and Skjærvöy. H.F. communication is generally good (so are the aircraft batteries) for it is possible to call Lödingen while sitting on the water at Gravdal and get the latest Narvik weather.

R/T. traffic is light, and this admits of a certain informality over the air. For instance, one morning it was found that there would be eleven passengers out of Gravdal, so it was agreed that I should be dropped off at Svolvær for the day. After giving Lödingen his "Airborne from Narvik" report, Rydland said, "Would you please telephone my friend Björn at Svolvær and ask him to look after an Englishman till I come back this afternoon?" The operator willingly agreed, and a few minutes later came back with, "Your friend say sorry, he is ill, but he fix another man. A'right?" As it turned out, he fixed a charming woman reporter from the *Lofotposten*, the leading northern newspaper. But that is another story.

During the long turn-rounds at Bodö there was time to talk more about the job of a pilot on this route. One might expect him to become bored, flying the same three short legs six days a week, but Rydland pointed out that the eternal variations of sea and sky are always giving surprises. As an example, on the second morning we crept low out of Ofot fjord, through a thick shower, and picked out the route rock by rock to Svolvær. On the water there we received a special message from Evensjær that Gravdal was reporting a 200ft cloud base, wind gusting up to 30 kt and 1,000 yards' visibility in heavy rain. There were no passengers or freight for Gravdal this time, only a few packets of letters, and it might have been considered fair to by-pass the place in view of the weather. But there is something of the Pony Express tradition about Widerøe's—"the mail must go through." So. "We'll go and have a look, anyway," said Rydland. Twenty-

Taking off, Svolvær.

five minutes after that report the Otter was water-borne at Gravdal—visibility a good three miles, cloud-base at least a thousand feet, and a young albatross wheeling serenely in the light breeze.

Another source of variety is the passengers themselves—as mixed a bag, if one may say this without suggesting disrespect, as on any other airline. There were two indefatigable elderly American lady travellers, protected in polythene from head to toe against the weather; Servicemen on leave; a girl-child with brilliant blue eyes and the most flaxen of hair who came up to visit the cockpit; a sad Frenchman going to visit a grave in the Allied cemetery at Narvik; and a preponderance of local fisher people, the kindliness of whose faces did not disguise the hardness of winter life in these wild islands.

Week-end charter trips can make a very pleasant change to the pilot's life. He may go off into the mountain lakes with a happy party of passengers to catch magnificent fish which they cook on the shore over a pinewood fire by the light of the midnight sun. It costs £20 per flying hour to charter a Norseman, but since the machine takes seven passengers, and there are hundreds of fine lakes within an hour of Narvik, the cost per head can be kept fairly low. The Otter—similarly powered, but representing a greater capital investment—is rather more expensive.

Pilots receive a reasonable basic salary, plus 15s an hour flying pay, so that their income compares favourably with that of S.A.S. crews; and as they are normally on a temporary posting to the North for the season only, they are all-found. There is not much flying to be done when they return to Oslo for the winter; thus they can recover from the heavy summer's work.

On the last day the weather was almost good on the leg to Svolvær, and as we left Gravdal the stratus clouds disintegrated and the sun actually broke through for the first time in five days. We craned forward hungrily in the cockpit to catch some of its warmth, and climbed to 3,000ft over a glassy sea. Once more, cinema-superlatives crowded inadequately to mind. With a slight turn we looked back on the full range of the Lofoten peaks, stretching over a hundred grotesque miles, dark against a brilliant sky. The horizon ahead was crenellated with mountains in disarray, and away to the south, on the Arctic Circle, snowfields of the Svartisen Glacier arose glistening in the sun. We looked down and tried to spot whales.

This account is finished next morning at four o'clock. The sun has shone brilliantly all night, and the DC-4 is now speeding south over that same glacier. It is almost painful trying to absorb and retain an impression of the snowfield's sublime grandeur while the smell of warm rolls and coffee issues from the galley aft. The four engines grind smoothly, the seats are soft, and the Australian lady in the next row vouchsafes the information that she has written 42 postcards, with a picture of the midnight sun on them, during her four hours beyond the Arctic Circle. Yet all this is infinitely detached, sophisticated and dull compared with scuttering around the screes below the Goat's Horns, to slide down into Svolvær's friendly little harbour, and shout "Morn!" to the postman in the patrol boat.

If I have to see anywhere and die, I had rather it were Norway's North than Naples.

HELICOPTER CONFERENCE—A POSTSCRIPT

TO see yourself as others see you is a good exercise for most of us, whether "us" means individuals, industries or countries. For the purpose of looking at ourselves in the helicopter industry, no mirror can be better than Rotterdam, the main port of an advanced and enterprising country. A country, moreover, with an unparalleled tradition in all branches of transport operations, but without a comprehensive aircraft industry of its own. In this environment the sound of grinding axes is multiplied by diversity and subdued by the presence of dispassionate judges, and so becomes a not unpleasant purr.

It was an act of faith and foresight on the part of the authorities in Rotterdam who joined together under the banner of the "Rotterdam Helicopter Syndicate" to organize and sponsor a conference of potential buyers and potential sellers of the transport helicopter. How great an element of faith is still needed in the active pursuit of helicopter plans was proved, not unnaturally, during the last session of the congress, a session devoted to economics.

In fact, it could be said that the preceding sessions were spent debating the propositions advanced by the last lecturer, Mr. Ledeboer of K.L.M. He proved in the most lucid manner, with the help of several diagrams, that two and two make four. In helicopter language, that the series of severe compromises which characterize *present-day* helicopter services can be worthwhile only under exceptional conditions and cannot even compete against express rail transport, with all its installations available and paid for. Most helicopter enthusiasts welcomed Mr. Ledeboer's statement, because each found in it some particular aspect of realism dear to his own views. This writer was mainly pleased with the emphasis on high frequency as an inseparable part of a fast transport service.

In the main, however, it is good to have one authority which cannot be swayed by enthusiasm: one of whom it can be said, "*et tu* K.L.M., then follow XYZ." My particular history book tells of an old weighing-machine at the university of Leyden which became the goal of all those unfortunate women accused of witchcraft in mediæval and renaissance Europe. A certificate from Leyden stating that she was possessed of measurable weight saved the wretched victim of malice and prejudice from the stake. It is good to have an authority which can certify sanity, including economic sanity.

Unhappily, we all know that the transport helicopter has no cause at present to apply for such a certificate, but can be used here and there to train the operator or the public and to serve special conditions. During this period it may not matter very much whether you lose a *little* money because a *small* vehicle is employed which cannot be economical or whether you lose a *lot* of money because you have not learnt to use a large and economical vehicle in a competitive manner.

It does not matter provided you believe that helicopters are coming. If you do, then the K.L.M. approach is irrelevant and the real question is how to prepare yourself most economically for the coming of the helicopter. The answer in North-West Europe would seem to be the one proposed by Vernieuwe of Sabena, namely, a co-operative enterprise by the European airlines. It is inconceivable that the soul of the Flying Dutchman should not respond to such an idea, and, on the whole, it has.

The contrast between present and future possibilities remains the central problem in transport helicopter planning and became the central theme of the congress. It was not always clearly distinguished by the various speakers, and listeners were often shuttled between the practical day-to-day problems of the existing and the wide sweep of the imagined. It could not even be said that the present was entirely the preserve of practical men or the future the playground of the theorists. Vernieuwe is the practical operator who strays into the dim future of the post-helicopter era, Mejer-Drees and Treibel the theorists who accept the limitations of the present in examining operating techniques and facilities.

The contrast between present and future appears to become a conflict when faced by city authorities with enough foresight to plan and build rotor stations. This writer hopes that they managed to find some guidance for action in the thoughts of the *designers* at both ends of the helicopter field. A fundamental chain of reasoning can lead to such guiding principles. In the future of flying of any kind, and of vertical flying in particular, much is uncertain. Perhaps the most hotly debated doctrines of configuration, type of power unit, and layout of operating sites are the least certain of all features. It is *certain*, however, that vertical or near vertical flight into the heart of cities is an improvement in communication which must come. Operating facilities and operating techniques will develop and reduce the demands on operating sites. Vehicle size and number of movements will grow and increase the demand on operating sites. It is reasonable to assume that the two developments will counterbalance each other.

In short, communities which fashion their sites to the demands of present-day imperfect helicopters with imperfect landing facilities are likely to find themselves ready for future perfect vehicles with perfect operating aids, whatever the shape of vehicles to come.

If it is possible to draw these conclusions from the many tendencies revealed during the four sessions then everything which was said falls into place in a panorama of which the details are obscure but the outline clear. The brush with which the details will be drawn is in the hands of the designers, who, on this occasion—however felicitous the conceptions they represented—graced their ceiling by modest understatement. This tone, adopted by Hislop (Fairey), was pursued by Morain (S.N.C.A.S.O.), and the representatives of Sikorsky and Piasecki.

Those who (like the present writer) have, despite constant re-examination, come to regard the helicopter as the generic form of air transport with the capacity of entering built-up areas must have taken away from this congress the conviction that we have at last come to a point when the designer can say "give us the job and we will finish the tools."

We hope that our hosts drew some such conclusion from this event to which they contributed not only their own invaluable experience in helicopter operations but a style of hospitality so perfect that even the ice-cream plates for the final supper were warmed.

J. S.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

The Moshaiski Claim

I WAS pleased to see the letter from Mr. Meos in the August 12th issue of Flight, which shows that, to some extent, your magazine is penetrating the Iron Curtain. Has there been any reciprocal exchange of British and Soviet aviation magazines yet, or is that a development in Anglo-Soviet relations still to come?

I should be very interested to know which British, French, Italian and American aircraft firms received drawings of Grigorovich's M-5, M-9 and M-15. Perhaps Mr. Meos would be good enough to tell us.

Your correspondent did not say what became of Moshaiski's aircraft after its claimed first, and presumably only, "flight," nor does he say anything about its duration, except that it was a "short flight." Perhaps he would clear up these points for us.

Dorchester, Dorset. J. P. ALEXANDER.

A "504" Revived

A SMALL error has crept into your August 26th issue, on page 278, concerning the Avro 504. It says that the Avro company bought up a somewhat battered 504N at Old Warden, where it had been part of the Shuttleworth collection.

The facts are as follows. The Avro 504N had been lying in a hangar at Portsmouth and belonged to the de Havilland company when I heard of it. I wrote to de Havillands, and they most generously presented the aircraft to the Shuttleworth Trust, even transporting it to Old Warden for us. I immediately got in touch with the Avro company, who kindly agreed to make it serviceable for us; this involved a complete rebuild, and construction of many parts which were missing.

The engine used is a Le Rhône, which belonged to the Shuttleworth Trust and originally came out of the Hanriot Biplane which Richard Shuttleworth bought in Brussels before the war and flew back to England.

The 504K is now at Kenley, where it has been reassembled ready to take part in the film *Reach for the Sky*. It was finally rigged and re-tested there on Friday, August 26th. Mr. Jackson did the rigging and I did the test. The flying for the film is perfectly straightforward, as befits a valuable veteran aeroplane. The Bristol Fighter also belonging to the Shuttleworth Trust is taking part in the film with the 504.

I mention all this because I would not like it thought that we are selling our veterans.

Twyford, Berks. A. H. WHEELER, A. Cdre.

[Our account of the discovery and transformation was based on information supplied by the manufacturers. A photograph of the aircraft appears on page 468 of this issue.—Ed.]

Mesmerised By Speed?

IN recording the recent 717 m.p.h. flight from Edinburgh to Farnborough by a Hunter, you commented: "The accuracy with which the aircraft must be flown to obtain maximum results can be seen by the fact that a reduction in flying time of just under two minutes resulted in an increase in speed of 37 m.p.h." Surely you are putting the cart before the horse: the time taken for any journey—even a record flight—is of much more fundamental importance and interest than the speed achieved *en route*.

The real moral to be learned from such flights, I feel, is the uselessness of high speed, for commercial purposes, over relatively short distances. Today we are in danger of becoming mesmerised by speed, which really means nothing more than a figure on a dial. If air transport continues to pursue speed to the exclusion of other, equally vital qualities, many years will pass before aircraft occupy their rightful place in the world's short- and medium-distance transport systems.

The potential passenger doesn't care twopence whether it takes 27 minutes or 72 minutes to fly from Edinburgh to London, but he is concerned about safety, economy and all-weather regularity, and these are the qualities which will sell the next generation of short/medium-range transport aircraft. No one doubts that aircraft are faster than any other means of transport: the manufacturer or operator who advertises his aircraft to the public on the basis of speed alone is preaching to the converted.

Thames Ditton, Surrey. J. B.

THE INDUSTRY IN BRIEF

Aviation and Engineering Supplies Pty., Ltd., of 134-142 Ferrars Street, South Melbourne, Victoria, have been appointed Australian agents for Blackburn and General Aircraft. Mr. C. J. H. Martin, of the Australian company, will be particularly concerned with the Beverley and Universal in Australia and New Zealand.

* * *

Formerly factory manager at the de Havilland Airspeed division at Christchurch, Mr. W. W. Warner has recently been appointed chief engineer to Airwork, Ltd.

* * *

The Fairey Aviation Co., Ltd., announce that Mr. Derek O. Thurgood has been appointed to their publicity department at 24 Bruton Street, London, W.1, from September 1st.

* * *

Sub-contract work to British aircraft specifications is now being undertaken by certain German firms. A. Ripley and Co., Ltd., of 11 Old Bond Street, London, W.1—from whom details can be obtained—state that the work is in the fields of manufacturing small components, instrument and other equipment, machined parts and presswork.

* * *

A Scottish tannery is supplying all the upholstery leather for the 60 Vickers-Armstrongs Viscounts for Capital Airlines. The leather, in a new green shade called Bogota, is treated against rot, mould and fungoid growths in hot humid climates and made crack-proof for extreme cold in sub-zero conditions. The upholstery is being supplied by the Bridge of Weir Leather Co., Ltd., Clydesdale Works, Bridge of Weir, Scotland.

* * *

The Pulsometer Engineering Co., Ltd., of Nine Elms Iron Works, Reading—well known as makers of aircraft fuel pumps—have just celebrated their 80th anniversary. Founded in Battersea in 1875 with 30 employees, and subsequently moving to nearby Nine Elms (a name perpetuated in their Berkshire address today) they began as manufacturers of a patented steam pump, in later years extending their activities to a much wider field, though still one mainly concerned with pumps. Today over 1,000 workpeople are employed at the Reading factory.

* * *

Mr. E. V. Norcock has recently joined the Board of Export Packing Service, Ltd. With Portsmouth Aviation, Ltd., in 1942, Mr. Norcock has since been with the Bristol Aeroplane Co., first as assistant commercial manager of the engine division and then as secretary of the aircraft division. He will now have special responsibilities for the E.P.S. research and development establishment and for the firm's commercial activities.

* * *

A James Clayton Fellowship has been awarded by the Institution of Mechanical Engineers to a Vickers-Armstrongs exapprentice, Mr. R. E. Catterwell, who is at present employed on production development work in the V-A guided weapons department. The scholarship is tenable at the College of Aeronautics, where Mr. Catterwell proposes to study aircraft production, with electronics as a subsidiary subject.

FORTHCOMING EVENTS

Sept. 12-18. Battle of Britain Week.
Sept. 19-23. Institute of Metals: Annual Meeting, Buxton.
Sept. 23. Yorkshire Aeroplane Club: Annual Ball, Harrogate.
Sept. 24. Aircraft Golfing Society: Brown Bros. (Aircraft) Trophy.
Sept. 25. St. Albans Model Aero Club: All Britain Model Aircraft Rally, Radlett Aerodrome.
Sept. 28-30. Institute of Physics: Ninth Annual Conference of the Stress and Analysis Group, Sheffield.
Oct. 7. Helicopter Association: "The Control of Helicopter Rotor Vibration," by P. R. Payne.
Nov. 11. Helicopter Association: "Design of Helicopter Operating Sites," by H. T. Hough, M.I.C.E., M.I.Mun.E., M.T.P.I.
Dec. 16. London Airport inauguration by H.M. the Queen.

R.Ae.S. Branch Fixtures (to October 19th)

Sept. 12, *Halton*, Films. Sept. 19, *Halton*, Films. Sept. 21, *Coventry*, Report on the Fifth Anglo-American Conference, by E. D. Keen and Dr. W. F. Hilton. Sept. 23, *Birmingham*, Branch area meeting: "Application of a Digital Computer to Gas Turbine Engineering," by G. C. Best. Sept. 26, *Halton*, Paper by an aircraft apprentice. Oct. 19, *Coventry*, "Cockpit Hoods," by Dr. Holland.

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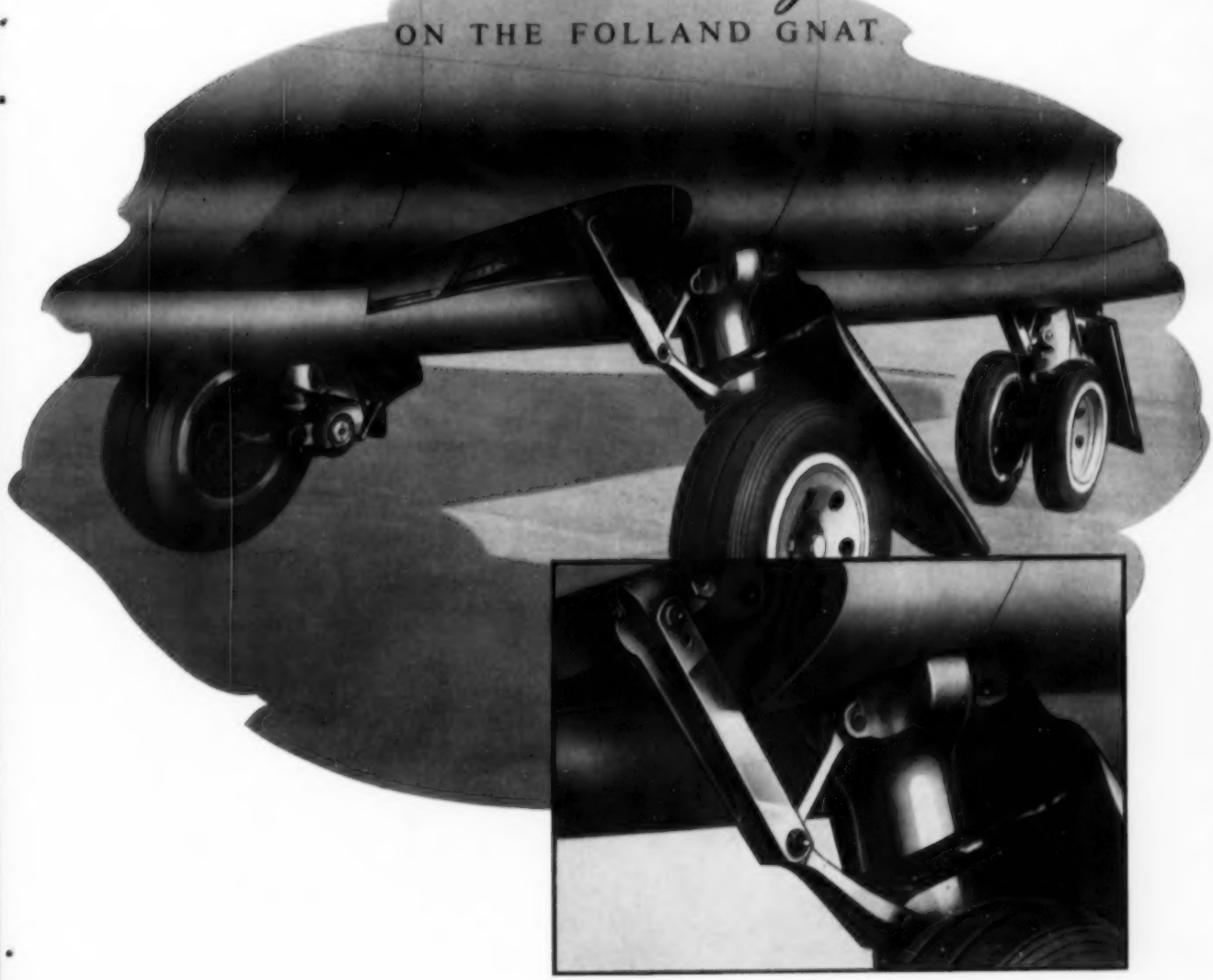

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B.O.A.C. photograph

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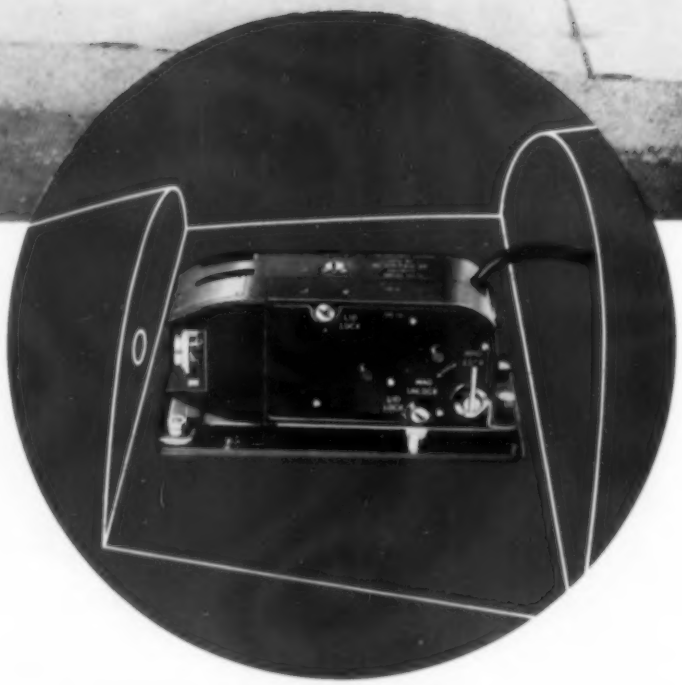

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HANDLING THE CESSNA 310

A Light Twin Five-Seater Cruising at over 200 m.p.h.

By C. M. LAMBERT

ONE of the major selling points of American light twin-engined executive aircraft is their cruising speed. The less ambitious designs, and the older types, travel sedately enough at about 140 m.p.h., but the latest variants and new models easily outstrip much larger aircraft.

The Cessna 310 which I recently flew from Croydon, in rather poor weather, will actually fly continuously at 218 m.p.h. But this is only 30 m.p.h. below its maximum permissible or "don't exceed" speed. Its maximum manœuvring speed is 158 m.p.h.; so, even cruising at the more modest 180-odd, one is restricted to "gentle manœuvres only." In fact this is a book limitation. The last 30 m.p.h. or so to "don't exceed" speed are not easily attained if the nose is allowed to drop; and the degree of manœuvrability available without straining the airframe is ample for all normal purposes.

The Cessna 310 does not, after all, claim to be a private-flying aircraft in the English sense, but rather a high-speed personal transport. The 218 m.p.h. (or 205 m.p.h.-plus given in the handbook) is its not unreasonable answer to the Convairliner's speed of about 280 m.p.h. A performance of this kind is what the American looks for when he buys an executive aircraft of the Cessna 310 type. For similar reasons, and in order to get the best use out of it, he equips it with every modern blind-flying and navigation aid and with extensive communications radio.

The owner of the Cessna which I flew, Mr. Calhoun Norton, (president of Arens Controls, Inc., of Evanston, Ill.) had installed the following: 22-channel H.F./R.T. with electrically winched trailing aerial; Lear 36-channel V.H.F./R.T.; Lear V.H.F. receiver with 12-channel transmitter and L.F. receiver; Omni-range meter and left/right pointer; and Lear A.D.F. 14 with bands from 190 to 430 kc/s and from 480 to 1725 kc/s. All these could be heard through a cabin loudspeaker or with earphones.

Using an adaptation designed by the Orion company and produced in the U.S.A. by R.C.A., Mr. Norton now intends to add a system which will combine the functions of I.L.S., V.O.R. and a Zero Reader, to form a simplified flight-director. All this is, of course, rather more ambitious than usual and very costly indeed, but it gives an indication of the sort of facilities which can be carried in aircraft of this type.

As it happened, when I actually flew with Mr. Norton from Croydon we had no complete common radio channel (since our V.H.F. transmitters would not cover 122.7 Mc/s). Neither, by an oversight, had we any large-scale maps on board. The gyro D.I. (fitted together with turn-and-slip indicator, artificial horizon, variometer and clock) could be slaved to one of the magnetic compasses, but when we took off this was no longer synchronized and indicated about 90 deg wrong. Ceiling was 2,000ft and visibility approximately one mile at about 1,800ft. Neither A.D.F. nor V.O.R. could get us within visual range of the airfield once we had left it, and the whole flight was made by flying a series of timed out-and-return legs, monitored with a plain magnetic compass.

Rather anxious uncertainty every time the airfield was due to come in sight ahead alternated with the great pleasure of handling the aircraft when outbound. It was an experience that I should not like to have missed.

A particular effort was made with the Cessna twin to attain the same cruising speed as the largest of the twins, but with much less power. So with two 240 h.p. Continental O-470B engines the Cessna cruises as fast as the Beech twin and Aero Commander, which have two Lycoming 290 h.p. engines each. This has been done by reducing both frontal and wetted area to the minimum. The fuselage is carefully streamlined and very short. The wing-span, at 35ft, is comparatively small, and all fuel is carried in two permanently attached tip-tanks (50 U.S. gal each) shaped to give end-plate effect. The engines are extremely closely cowled, with oil-cooler honeycombs set in one of the cylinder-cooling air inlets, and carburettor air taken from the other inlet. The undercarriage retracts inwards into the wing centre-section, so that the absolute maximum of wing area is available for useful aerodynamic purposes. This makes for low drag and high speed on comparatively little power, but has its penalties in definite stalling characteristics. The aircraft must be flown with a caution equal to that required, say, for a Harvard, and not treated like a light club machine.

Needless to say, the interior appointments and such items as air-conditioning, heating and sound-proofing are well up to American standards. Instrumentation and cockpit layout also are careful and clear. Maintenance is not quite so easy as, for example, on Piper aircraft, but such work is not really intended to be done by the owner himself.

Accommodation is for five, with three on a bench seat in the back and two pilots in separate seats in the front. These seats are adjustable for fore-and-aft travel and for pitch as well; they can therefore be arranged to suit even the most complicated and fastidious anatomy. Rudder pedals, with hydraulic toe brakes, are not adjustable. All engine controls are on a central pedestal; and the nosewheel is steerable from the rudder pedals.

The Cessna is all-electric and flaps and undercarriage are controlled by widely separated switches on the main panel. Emergency undercarriage-lowering is by a hand-crank located just beside the first pilot's seat. Fuel-system control is by two cocks, one for each engine, by which fuel can be taken from either tank—a "built-in" cross-feed which can save a great deal of study and trouble in emergencies. For my flight we had tip-tanks full and an extra 50-gallon cabin tank in the rear partly full. This last had been added for the Atlantic crossing.

There is one access door, to starboard, which is held open by a clip on the engine cowling. Access is from the rear, by

The clean and economical lines of the Cessna 310 at once suggest high performance, just as the array of aerials of various types denotes elaborate radio equipment. The aircraft is here seen at Croydon.

"Flight" photograph

HANDLING THE CESSNA 310 . . .

The Cessna's instrument panel is workmanlike, with radio-compass, course selector and V.O.R. dial at extreme left, and blind-flying instruments alongside. Engine instruments are grouped to the right with a single fuel gauge, suction gauge, outside air temperature gauge and stall-warning horn. The bank of switches and knobs below the main panel covers radio and air-conditioning controls. Magneto and booster pump switches are, in this view, obscured by the control wheel on the port side.

climbing on to the wing with the aid of a convenient footstep and handle. The right-hand seat slides forward or back out of the way for pilots or passengers. First move before flying is to take the control-locking plate off the control column, thus exposing the magneto switches and starter buttons. Otherwise they are blanked off, so that no casual visitor can press the wrong button. Starting procedure is normal: fuel on, switches on, press starter button, apply fuel boost pump after one airscrew revolution, and switch on primer if the engine does not catch quickly.

The view over the nose while taxying is perfect and control very easy. The control wheel is not touched until the actual take-off; one simply sets the throttles and uses the rudder pedals. Hands are therefore free to tune radios, set gyros, prepare maps and give hand signals if required. We lined up, set trims at neutral, checked booster pumps "on" and applied power. The take-off run is short and the climb can be as high as 1,850ft/min. On this day we had to level off soon because of the indeterminate cloud-base.

I took over control and levelled off to cruise at 2,400 r.p.m., reaching about 190 m.p.h. as soon as the aircraft was "over the step." Trim changes with power were fairly pronounced, and the nose was very low on the horizon while cruising. In fact it took me some time to realize just how low it had to be, and each time I wound the trim farther forward the speed crept steadily up, and still we seemed to be climbing. This certainly was performance! In order to keep track of our progress more easily I then settled back to 180 m.p.h. and proceeded to try the controls.

Damping in yaw was good, but the rudder was somewhat sloppy. Laterally the aircraft was ostensibly neutrally stable, but some control friction prevented the roll from stopping if once applied unless the wheel was actually put back to centre. Fore-and-aft, remarkably, the Cessna 310 gives the effect of neutral stability and the nose will stay where it is put outside the trimmed attitude unless and until there is some considerable change in speed. This, however, remains substantially constant for a considerable time and the result is to all intents and purposes a neutral stability. Stick forces are very pleasantly light and response precise and positive. The rate of roll, particularly, is very high for such an aircraft; and Mr. Norton said it felt "just like a military airplane," and I fully agreed with him.

The position at lower speeds was not nearly so bright. At 120 m.p.h., with a goodly load on board, the Cessna is very sloppy and has to be flown and watched. Gone is that encouraging feeling of smooth, effortless speed. I put down some flap and then the undercarriage as well, and with a higher power setting the aircraft was much steadier. With the cloud-base down to 2,000ft we had not enough height to try a stall, although the handbook said that the maximum height-loss would be only 400ft and the maximum pitch-angle 45 deg. Visibility and ceiling however strictly discouraged any attempt to prove these statements. Neither did I want to stop an engine completely, although the aircraft will easily climb "on one" and has in fact a single-engined ceiling near 9,000ft. I throttled the port engine back and put it into coarse pitch, causing greater drag on that side than if it had been stopped and feathered, though its power was still instantly available if needed. With flaps and wheels up and maximum cruising setting on the "good" engine the speed settled at just below 120 m.p.h. The rudder trim wheel is too small and too stiff, and too little of it projects from the control pedestal, but this heavy drag on one side could be trimmed right out and the machine flown "hands off." Aileron trim on a similar wheel is also available, but was not required in this case.

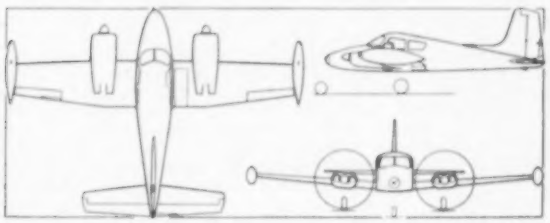
After a little more D.R. navigation of an exploratory nature I flew up to Croydon and joined the circuit. Downwind checks were usual, with the addition of fuel booster pumps "on." Wheels and lift flap came down at 130 m.p.h. and the final approach, with a trickle of power, was made at not less than 100 m.p.h. This was purely a safety measure to keep above the single-engined critical speed (95 m.p.h.) as long as possible. In fact the approach can be made, with plenty of power, at about 85 m.p.h. and the landing-run limited to about 300 yd. At 100 m.p.h., with full flap, the angle of descent is quite steep. Care must be taken not to cut the throttles completely, but to pull them back gently all the way through the round-out and cut only when the aircraft is almost down on the runway, in order

"Flight" photographs

The extremely close cowling of the 240 h.p. Continental engines can be seen in this front view. The airscrews are Hartzell, two-blade, metal, constant-speed and fully-feathering units. Oil-cooler honeycombs are set just inside one of the cooling air intakes on each engine. The main undercarriage units retract inwards into the wings.

Cessna 310 (two 240 h.p. Continental O-470B engines)

Span, 35ft 8in; length, 27ft; height, 10ft 5in; wing loading, 24.6 lb/sq ft; power loading, 8.9 lb/h.p.; all-up weight, 4,600 lb; fuel capacity, 100 U.S. gal (50 U.S. gal or 100 U.S. gal cabin tanks can be fitted); top speed, 220 m.p.h.; cruising and consumption, 70 per cent power, 8,000ft, 205 m.p.h., 23 gal/hr; range, at 50 per cent power, 10,000ft, 1,000 miles; service ceiling, 22,000ft; rate of climb, sea level, 1,850ft/min; single-engined service ceiling, 9,300ft; single-engined rate of climb, 470ft/min.



"Flight" photograph

The single entry door, here shown clipped open, has a hand-hold recessed in the elbow rest. The seat slides forward or backward to allow easy access for pilots or passengers, and the seat-pan angle can be adjusted to suit varying leg-lengths. Seat covers are plastic.

to avoid a sharp sink to the runway from about 15ft.

I rounded out gently and began to hold off, taking off the last bit of power. There was little float and after a few seconds the nosewheel made contact with the ground, the main wheels following suit immediately afterwards. There was no tendency to bounce at all and the oleos appeared to be very well balanced. Touch-down is normally in almost the three-point position and brakes can be applied immediately. These characteristics, and nosewheel steering, give immediate and positive control throughout the landing run.

Altogether the Cessna 310 is an impressive aircraft, offering advanced performance, but demanding experience from the pilot. This Mr. Norton has in full measure, as has his co-pilot and business associate Mr. R. Gruman. Both are ex-members of the U.S.A.F.'s Strategic Air Command, with combat experience of B-29 operation at a time when General Curtis Le May's theories on strategic operations were first being put to the test. Their transatlantic flight had been made from Chicago and Westfield, New Jersey, *via* Goose Bay, Bluie West One, Reykjavik and Prestwick, in a flying time, from B.W.1, of 16 hr 15 min.

The longest hop was 6 hr 55 min between B.W.1 and Reykjavik, three-and-a-half hours of it I.F.R. On this leg the aircraft was cleared for a height of 15,000ft. With extra tankage giving 7.5 hr endurance, two people and baggage, this height was easily reached, but the trailing aerial of the H.F./R.T. set broke away and Mr. Norton climbed into the back to try to rig a new one so that they could call for clearance at a lower altitude. This was a rather tiring job at that height, and icing at lower levels in any case soon forced them to maintain their cleared height. They were bound for Keflavik, but were forced to divert to Reykjavik because of low ceiling and poor visibility, and they finally reached the airfield with 30 gallons of fuel left.

This gives a good idea of what the aircraft can do. I noted that the maximum load factor is 3.8g, and with flaps down this goes down to 2.0g; but even bearing these figures in mind, I was greatly attracted by the Cessna 310 and liked its high performance. It is a satisfying and exhilarating aircraft to fly.

PROFIT IN PERSPECTIVE

(Continued from page 453)

costs quoted for the B.E.A. Viscount are excessively high. The Corporation's Viscount fleet alone would have lost well over £1m in 1954-55 had its earnings per ton-mile corresponded to the average yield on U.S. domestic routes.

Some Conclusions.—The recent improvement in B.E.A.'s financial state reflects credit on the Corporation's management and staff, but should not divert attention from two fundamental aims; increased productivity and reduced charges to the consumer wherever possible. How serious is the need for increased productivity is shown by the report's statement that "in the summer of 1955 staff wage claims amounting in total to more than £500,000 per annum were outstanding."

Profits from international routes should not be regarded as a means of balancing deficits incurred on short-haul, poorly patronized domestic services. The international and domestic networks represent two totally different markets: at present both are suffering from the ill effects of over-centralization. The development of a network of fast, frequent air services on domestic routes, economic to both operator and user, is hampered by the high level of Government fuel charges and landing fees and by the absence of an aircraft designed for the purpose. Pending the removal of these barriers, the opportunities now open to B.E.A. in international routes should be exploited to the full. A clearer separation between the domestic and international spheres would enable the Corporation to declare its "social services" deficit with a clear conscience, and might force the Government to adopt a more positive policy towards air transport within the U.K.

BATTLE OF BRITAIN DAY

IN accordance with a decision by the Air Council to minimize interference with air traffic in the London control zone, Battle of Britain fly-pasts over London on September 15th will be smaller than usual. The traditional Hurricane and Spitfire will again lead, and will be followed by 48 Hunters of the R.A.F., 12 Sea Hawks of the Royal Navy and 12 F-86D Sabres of the United States Air Force.

More than a million visitors are expected to attend the 46 R.A.F. stations which are to be "At Home" to the public on Saturday, September 17th. Last year, there was a record attendance of over 1,200,000, and although fewer stations will be open this year, they have been chosen so as to allow as many people as possible to see the work and recreation of the R.A.F. Admission will again be free. Proceeds from car parks and programme sales—last year amounting to £23,774—will again be shared between the R.A.F. Benevolent Fund and the R.A.F. Association. Stations "At Home" are:—

Buckinghamshire—Halton. *Cambridgeshire*—Duxford. *Cheshire*—Hooton Park. *Cornwall*—St. Mawgan. *Devon*—Chivenor. *Essex*—Debden. *Gloucestershire*—Filton, Little Rissington. *Hampshire*—Andover, Thorney Island. *Kent*—Biggin Hill, West Malling. *Lancashire*—Kirkham. *Lincolnshire*—Binbrook, Hemswell. *Middlesex*—Hendon. *Norfolk*—Horsham St. Faith. *Northumberland*—Acklington. *Oxfordshire*—Benson. *Shropshire*—Shawbury. *Somerset*—Locking. *Staffordshire*—Cosford, Lichfield. *Suffolk*—Wattisham. *Surrey*—Headley Court. *Sussex*—Tangmere. *Warwickshire*—Castle Bromwich, Wellesbourne Mountford. *Wiltshire*—Hullavington. *Yorkshire*—Catterick, Church Fenton, Leconfield, Lindholme, Norton, Thornaby. *Scotland*—Bishopbriggs, Dyce, Kinloss, Leuchars, Turnhouse, West Freugh.

S.B.A.C. SCHOLARSHIP WINNERS

THE Society of British Aircraft Constructors has announced the names of successful candidates for its annual university and educational grants.

The Society's standing committee on education has granted second-year scholarships to R. A. Gellatly and M. J. Goldsmith at Imperial College, and F. R. Ayers, N. Birch, D. H. Ralston and M. R. Williams at the College of Aeronautics.

Six candidates were awarded 1955 university scholarships: E. M. Cowburn (Blackburn and General Aircraft), E. R. Kendall (Saunders-Roe), A. Lawson (A. V. Roe), J. A. Leitch (Rolls-Royce), D. J. Stewart (Vickers-Armstrongs Supermarine), and D. M. Squires (de Havilland Engine Co.). These students will be going to the College of Aeronautics.

An educational grant was awarded to B. H. Jones, who is an engineering apprentice with de Havilland Aircraft.

CIVIL AVIATION

B.O.A.C.'s Report for 1954-55

IN the financial year ended March 31st, 1955, British Overseas Airways Corporation made a net profit of £261,687, compared with a figure of £1,065,397 in the previous year. The Corporation's annual report for 1954-55, published on September 2nd, shows that capacity offered, traffic carried and revenue earned all declined at a time when B.O.A.C.'s competitors were increasing their production by up to 20 per cent.

The reason for this setback was, of course, the withdrawal from service in April 1954 of B.O.A.C.'s Comet Is, which would have provided 21 per cent of total capacity during the year. The main emergency measures taken—acquisition of second-hand Constellations and Stratocruisers, and a stepping-up of fleet utilization—kept the fall in production at a minimum: the total of capacity ton-miles offered was in fact only 2.6 per cent less than in the previous year. For the first time in several years, however, the cost per c.t.m. increased—from 39.2 pence to 39.9 pence. The primary cause of this increase was the need to write off prematurely all development expenditure incurred in preparation for the introduction of the Comets.

"It is impracticable," the report states, "to estimate precisely the financial effect of the withdrawal of the Comets. Residual development expenditure, amounting to £619,936, had to be written-off; there was a direct capital loss of £1,730,259 on Comet 1 fleet and equipment; and there was a loss of revenue which the aircraft would have attracted to the Corporation. In addition, the replacement aircraft could only be bought at 'top-of-the-market' prices which, in many instances, were greater than the cost of the same aircraft when new, thus leaving a legacy of high operating costs to be borne during the continuing life of these aircraft in the Corporation's fleet."

At the end of the financial year reviewed B.O.A.C. were operating only 43 revenue earning aircraft—22 Argonauts, 11 Constellations and ten Stratocruisers. These aircraft, however, logged almost as many revenue flying hours on scheduled passenger services as in the previous year (133,428 compared with 135,010), when the revenue fleet consisted of 54 aircraft. This achievement is credited largely to an increase in utilization of the Argonaut fleet, whose aircraft each averaged 3,394 hours during the year. It was necessary, however, to withdraw services to South America in April 1954. This withdrawal was a temporary measure, and the Corporation is retaining key station and sales staff in South America "in readiness for the re-opening of services when suitable aircraft became available."

From the commercial viewpoint, the most significant trend of the year was a substantial increase in the proportion of passengers flying on B.O.A.C.'s tourist services. In 1952-53, the period in which these services were introduced, tourists comprised 13.5 per cent of all B.O.A.C.'s passengers. In the following year the proportion was 32.5 per cent, and in 1954-55 the proportion of tourist-class passengers was 45.2 per cent. The total number of passengers carried during the year was 291,136, compared with 304,980 in 1953-54. Average distance flown per passenger was 3,108 miles. The passenger load factor dropped from 63.5 per cent to 61.6 per cent, and revenue from this source dropped by 5.4 per cent to £22,900,117.

The use of piston-engined aircraft in place of Comets resulted in an increase in freight capacity offered, and as a result B.O.A.C. carried 6,003 tons of cargo compared with 5,409 tons in the previous year; freight revenue increased from £2,942,294 to £3,453,042. Withdrawal of the Comets, however, resulted in the transfer of mail traffic to other operators (mainly Commonwealth airlines) and revenue from this source was reduced from £9,059,879 to £8,800,730. The actual volume of mail carried increased slightly but this was offset by a 5 per cent drop in the percentage of first-class mail.

Discussing re-equipment, the report recalls that during the year reviewed the Corporation increased its order from 25 to 33 Britannias. Four of the 15 Britannia 100s on order are due for delivery by the end of this year and the remainder between January and August 1956. Scheduled passenger services with these aircraft are due to begin in April 1956. Delivery of seven Britannia 300s is promised during the second half of 1956 and of all 11 Britannia 300 L.R.s between October 1956 and April 1957.

One of the 20 Comets ordered by B.O.A.C. will be a Series 2 airframe with Avon RA.29s of the type to be installed in the Series 4s making up the remainder of the order. The modified Comet 2 will be flown intensively by B.O.A.C. to gain operational experience and, under arrangements with the Ministry of Supply, for engine development. Delivery of the 19 Comet 4s is expected to begin during the second half of 1958.

Ten Douglas DC-7C Seven Seas were ordered "as an insurance that the Corporation is not left without aircraft capable of operating non-stop over the North Atlantic if there are any delays in the delivery of the aircraft now on order." The American aircraft are due for delivery between October 1956 and May 1957. The report recalls that "an express undertaking was given to the M.T.C.A. that the aircraft would be sold when the long-range Britannia 300s are in scheduled service on the North Atlantic."

The report devotes special attention to the subject of co-operation with British independent airlines. It states that all practicable assistance was offered by B.O.A.C. to Airwork in the establishment and operation of North Atlantic all-freight services. An agreement was also reached with Hunting-Clan, under which the Corporation will co-operate with the independent airline in the development of its new Africargo services; and a short-term charter agreement with Skyways provides for that company's operation of the B.O.A.C. freight service between London and Singapore. B.O.A.C. have retained the franchise of the Singapore service and they are responsible for both sale of freight capacity and ground-handling of aircraft. Co-operation between B.O.A.C., Hunting-Clan and Skyways resulted in the establishment of the Mideast Aircraft Servicing Company (MASCO) in Beirut which, using three aircraft hired from Hunting-Clan, will shortly begin Viscount services on behalf of Middle East Airlines and Kuwait Airways. The report adds that: "Negotiations are in an exploratory stage for the joint establishment by the Corporation and by independent companies of further regional companies in other parts of the world."

	1954-55	1953-54	Percentage Variation
Net profit or loss	+ £261,687	+ £1,065,397	
Traffic revenue	£36,609,979	£38,077,197	−3.9
Operating revenue	£36,866,199	£38,361,337	−3.8
Expenditure	£35,746,979	£36,203,546	−1.3
Capacity ton-miles offered	214,924,282	220,530,209	−2.6
Load ton-miles sold	139,000,648	145,593,003	−4.5
Revenue load factor	63.7	64.5	
Passengers carried	291,136	304,980	−4.5
Passenger load factor	61.6	63.5	
Passenger-miles flown	905,740,127	968,814,703	−6.5
Mail carried (tons)	3,407.3	3,366.1	+1.2
Freight carried (tons)	6,003	5,408.6	+9.9
Average number of staff	17,062	17,255	−1.1

A.N.A.'s VETERAN DC-3

OF the many DC-3s flying in the British Commonwealth, it is certain that none has logged more hours than VH-ABR *Kanana*, one of 20 operated by Australian National Airways. At midsummer of this year, *Kanana* had logged the almost unprecedented total of 46,113 hours and flown more than 7,000,000 miles in 16 years of continuous service. During this period it had carried about 274,000 passengers with a perfect safety record.

Kanana was purchased from Douglas by A.N.A. in September 1938 and went into service in November of the same year. Early in 1941 VH-ABR was impressed into the R.A.A.F. and was not returned to A.N.A. until the end of 1944. Its war service included many hundreds of flights between Australia, New Guinea, Manila, Fiji and even to Singapore, carrying Allied troops and military supplies. It was also engaged in the evacuation of civilians from New Guinea and Rabaul just before the Japanese occupation, and on a few occasions VH-ABR even took part in anti-submarine reconnaissance patrols off the North Australian coast.

Returned to A.N.A. after the war, VH-ABR underwent an extended major overhaul in the airline's workshops at Essendon Airport. Passenger seats were increased from 21 to 24, and the Wright Cyclone GR-1820-G2 engines were replaced by more powerful (1,200 h.p.) Wright GR-1820-G202A (all A.N.A.'s DC-3s are now fitted with the latter powerplants). Hamilton Standard Hydromatic fully feathering propellers were also fitted as part of a programme to bring the aircraft to full post-war standards for the type.

VH-ABR usually flies with other A.N.A. DC-3s on the relatively unglamorous feeder schedules from Cairns (N. Queens-

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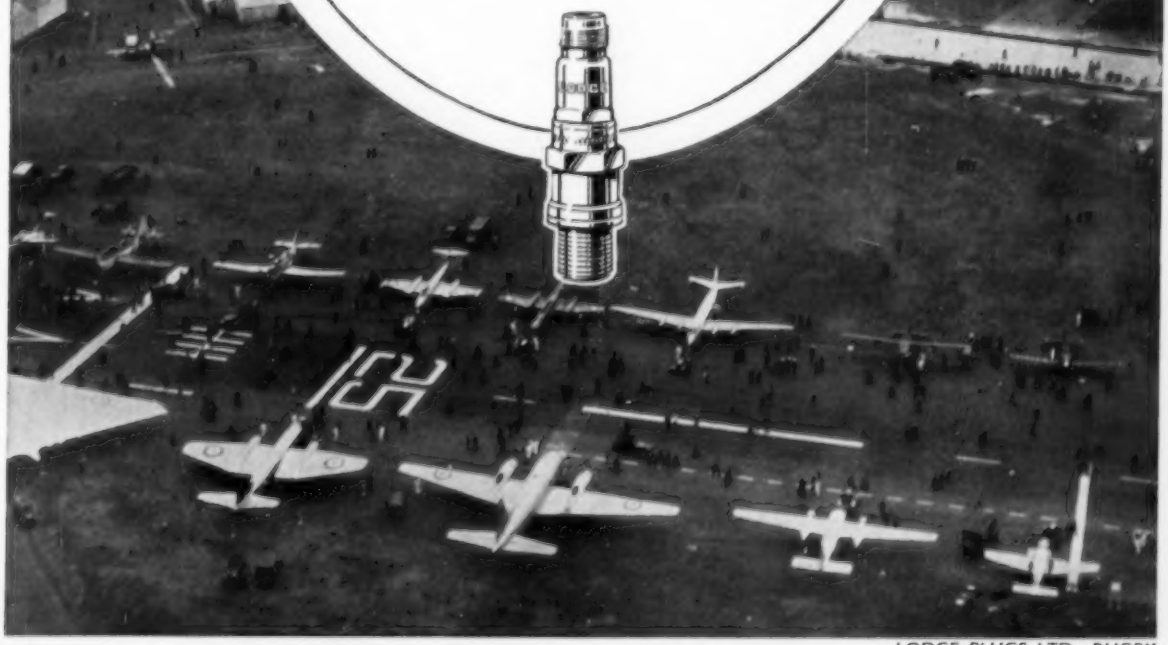

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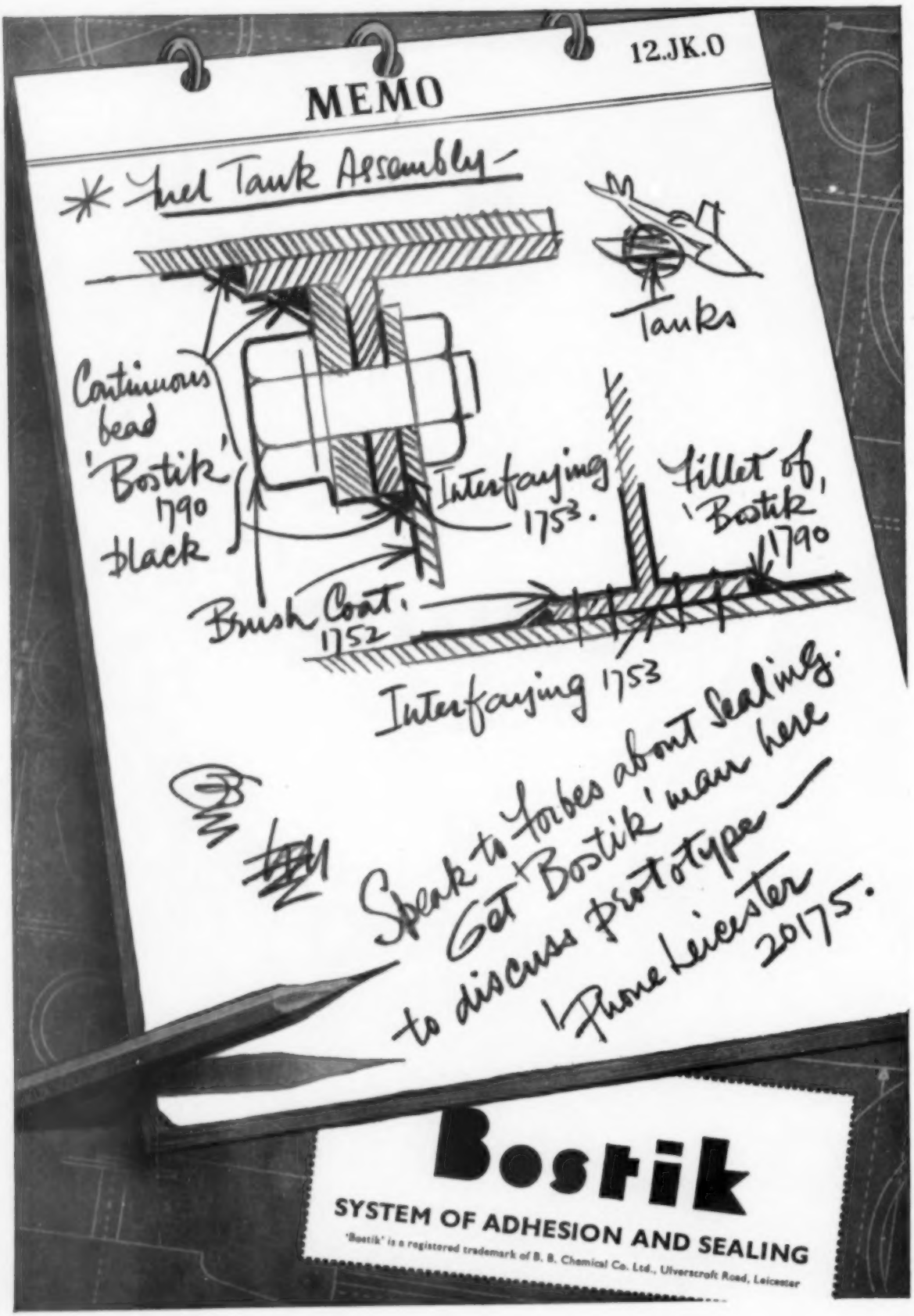
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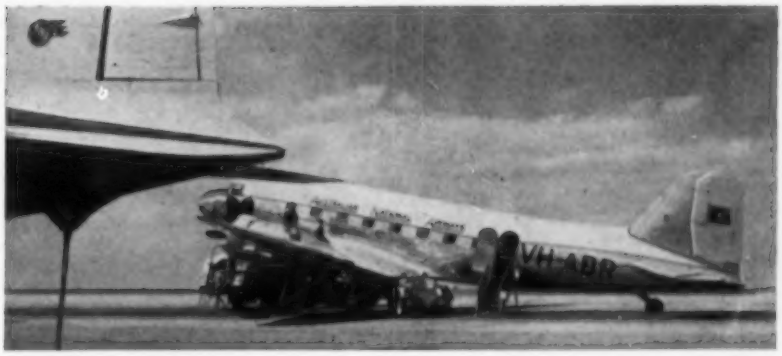
CIVIL AVIATION . . .

land), linking this Australian coastal town with the inland and coastal network of small towns including Burketown, Galbraith, Inkerman, Mitchell River, Koolatah, Dunbar, Vanrook, Miranda and thence back to Cairns. Here passengers change aircraft and fly on one of A.N.A.'s busiest DC-4 and DC-6 schedules—to Brisbane, Sydney, Canberra and Melbourne and *vice versa*.

In view of *Kanana's* fine record, it is not surprising to learn that two other pre-war DC-3s owned by A.N.A.—VH-UZK and VH-UZJ—achieved the very impressive totals of 34,200 and 37,000 hours respectively before they were "retired" and (sad to recall) were scrapped back in 1950. D. M. P.



"Kanana," the veteran DC-3 referred to on page 464. It went into service with Australian National Airways 17 years ago and has since logged more than 46,000 flying hours.

DECCA APPOINTMENT

THE formation of an airlines department within the company's air division is announced by the Decca Navigator Co. The new department will be headed by Mr. J. G. Adam, who, until September 1st, was communications superintendent of B.E.A., with whom he had been employed for nine years.

As all B.E.A.'s Viscounts are equipped with the Decca Navigator and Flight Log, Mr. Adam has had the opportunity to assess the merits of the system relative to the needs of a large airline. In his new appointment he will be responsible for advising prospective airline users on the application of Decca, and ensuring that present users are deriving the maximum benefit from their equipment. Explaining the decision to set up an airlines division, the Decca Co. express their belief that their system ". . . has benefited by the recent, and still very active, VOR-TACAN dispute. When it is remembered that the distance measuring half of the original VOR/DME concept will never be available, that the technical validity of VOR itself is now being questioned by those who once supported it and that the VOR deployment in Europe only totals, at this late stage, 13 beacons, it is not surprising that many operators are seriously considering Decca as the answer to their urgent requirement for better navigational assistance."

Mr. J. G. Adam.

THE GUILD'S COURT

THE constitution of the Court of the Guild of Air Pilots and Air Navigators for 1955-56 has recently been announced. Names of the officers concerned are as follows:—

Grand Master.—H.R.H. the Duke of Edinburgh.

Master.—Capt. J. C. Harrington.

Immediate Past Master.—Capt. D. A. Brice.

Honorary Wardens.—Field Marshal Viscount Montgomery; Marshal of the Royal Air Force Viscount Trenchard; Marshal of the Royal Air Force Sir John M. Salmond; Marshal of the Royal Air Force Sir Edward L. Ellington; Marshal of the Royal Air Force Lord Newall; Marshal of the Royal Air Force Lord Douglas of Kirtleside; The Rt. Hon. Lord McGowan; Sir Matthew Drysdale; J. A. Pollen; H. O. Short.

Wardens.—Capt. B. C. Frost; Capt. O. P. Jones; Capt. A. G. Lamplugh; J. Lankester Parker; Sir Frederick Tymms.

Assistants

Members.—W/C. C. A. Pike; S/L. J. C. C. Taylor; C. H. Willis; D. V. C. Cotes-Preedy; Capt. J. B. Linton; G. A. V. Tyson; Capt. A. S. Wilcockson; Capt. W. R. Mitchell; E. B. Trubshaw.

Associate Members.—J. D. R. Bethell; Dr. K. G. Bergin.

Service Members.—Air Chief Marshal Sir John N. Boothman; S/L. J. E. Bazalgette.

Test-pilot Section.—S/L. F. Murphy; Lt. D. W. Morgan.

In Attendance

Honorary Chaplain, Rev. Leslie Wright; **Deputy Honorary Chaplain,** Rev. Can. Guy Bowden; **Assistant Hon. Chaplain,** Rev. Gordon Hyslop; **Hon. Medical Advisers,** A. Cdre. R. W. Ryan; Dr. K. G. Bergin; **Hon. Court Editor,** C. A. Nepean Bishop; **Clerk,** L. A. Wingfield; **Secretary,** Maj. J. L. B. H. Cordes.

WEST MED. CONTRACT FOR EAGLE

A GOVERNMENT trooping contract worth approximately £1½m was announced last week by Mr. Harold Bamberg, chairman and managing director of Eagle Aviation Ltd. It involves the carriage of troops and families to Malta, Gibraltar, Tripolitania and Cyrenaica.

Eagle will use their special Troopmaster Viking aircraft for the contract which will start on October 1st, 1955, will continue for a minimum period of two years and will possibly be extended for a further year. Designated as the West Med. Contract, it is described as one of the largest trooping commitments undertaken by a private British operator.

SERVICE AMENDMENTS APPROVED

THE Minister of Transport and Civil Aviation, after considering the recommendations of the Air Transport Advisory Council, has approved the following applications for amendments to air services:

B.K.S. Air Transport, Ltd.—An increase in frequency from seven to 21 return flights per week on the internal service between Leeds (Yeadon) and Southend.

Hunting-Clan Air Transport, Ltd.—An increase in frequency from one return flight per 28 days to one return flight per fortnight on the Colonial Coach class service between London and Gibraltar.

Skyways, Ltd.—The continued operation until 26th October, 1958, of the Colonial Coach class service between London and Cyprus at an increased frequency of one return service per week.

BREVITIES

MANCHESTER will be the venue of the 1955 annual conference of the Aerodrome Owners' Association, to be held on September 29-30th. The programme includes visits to Manchester Airport and the Fairey Aviation Co. works at Heaton Chapel; a helicopter demonstration is also scheduled.

* * *

Orders have now been placed for 99 Douglas Seven Seas. Construction of the first DC-7C, due for delivery to Pan American early next year, is reported to be "right on schedule"; the fuselage, to which the nose was joined last week, has now assumed recognizable form.

* * *

Formerly general manager (stations and traffic) of B.O.A.C., Mr. H. O. Houchen took up on September 1st a new appointment as the Corporation's deputy operations director. The operations director of B.O.A.C. is Sir Victor Tait, and until September 1st there were two deputy operations directors—Mr. C. Abell (engineering) and Capt. J. C. Harrington (operations). Mr. Abell's and Capt. Harrington's responsibilities are unchanged, but their titles are now chief engineer and deputy director, flight operations, respectively. Mr. Houchen, who was born in New Zealand 47 years ago, joined B.O.A.C. in 1944 as regional engineering superintendent, Middle East. Mr. J. R. Stainton succeeds him as general manager (stations and traffic).

Mr. H. O. Houchen.

Civil Aviation

AGRICULTURAL CZECH

THE accompanying photograph shows the prototype L-60 Brigadyr, which is now going into production in Czechoslovakia and is marketed by the Motokov Sales Organisation. Although bearing certain points of resemblance to the Fieseler Storch and to other famous types, the design is entirely original and has been carried out by the Avia company in Czechoslovakia since 1952.

Power is provided by a cleaned-up Praga Doris B, a very efficient and attractive flat-six engine of 200/210 horse-power. Some notes on this engine were given in our report on the Paris *Salôn* earlier this year. The installation is quite neat, cooling air being taken in through a semi-annular intake beneath the spinner and discharged through multiple louvres on each side above the cylinders, the cowling being otherwise sealed. There are individual ejector exhausts for each cylinder. The airscrew is a two-blade unit with a large spinner, and can be of the variable-pitch type.

Aerodynamically the machine differs little from other types intended for sustained flying at low airspeeds. Each wing carries a full-span one-piece leading-edge slat, and highly effective double-slotted flaps are fitted in continuous sections between the cabin and the ailerons. The tail volume is exceptionally large, this being another characteristic of slow-speed machines.

For agricultural work any of the usual array of dusting and spraying gear can be provided. For spraying, a 77-gal cylindrical tank can be mounted behind the pilot's seat, fluid being discharged by a ventral windmill pump through conventional spray-bars which extend almost the full span. For dusting, the load is approximately 700 lb, the flow being agitated by a windmill mounted above the cabin and discharged from a curiously engineered ventral hopper which is visible in the photograph.

The resemblance of the Avia L-60 Brigadyr to the Fieseler Storch is emphasized in this view. The new machine is powered by a Praga Doris B engine.

Production deliveries are due to start before February next year. No price is yet available but it is understood that the type will be exported. Large numbers are to be built for all the Soviet countries where they will supersede the ageing PO-2 biplanes.

L-60 Data.—One 200/210 h.p. Praga Doris B air-cooled piston engine. Span, 45ft 10in; length, 28ft; height, 8ft 10in; wing area, 261 sq ft; basic weight, 1,896 lb; disposable load, 1,124 lb; maximum weight, 3,020 lb; wing loading, 11.97 lb/sq ft; maximum speed 121 m.p.h.; maximum continuous speed, 110-116 m.p.h.; minimum speed (can be used for spraying), 34 m.p.h.; service ceiling, 17,390ft; climb to 9,843ft in 18.5 min; take-off run, 420ft; landing run, 341ft; distance to 50ft, 770ft; landing from 50ft, 656ft; range at 3,280ft, 435 miles.

CONVAIR CONVERSION

THE conversion of surplus Convair L-13A aircraft by Caribbean Traders, Inc., of Miami, Florida, has recently opened another phase of small field and strip operations in the mountainous West Indies Islands and similar terrain in Central and South America. Now named the Husky, the L-13A has been modified after many hours of engineering study and test flying, with a consequent marked improvement in its flight characteristics. The folding mechanism of the wing and tailplane has been left unaltered.

Three powerplants are available for the new conversion. The Husky Mk I will retain its original powerplant, a Franklin 0-425-9, of 245 h.p.; the Mark II will be powered by a Lycoming R-680-13 of 300 h.p.; and the Mark III will have a Pratt and Whitney R-985-7 of 450 h.p. All three types will incorporate a swinging engine-mount and quick-disconnect firewall fittings for easy maintenance. A constant-speed Hamilton Standard airscrew replaces the wooden variable-pitch type on all Mk II and Mk III conversions.

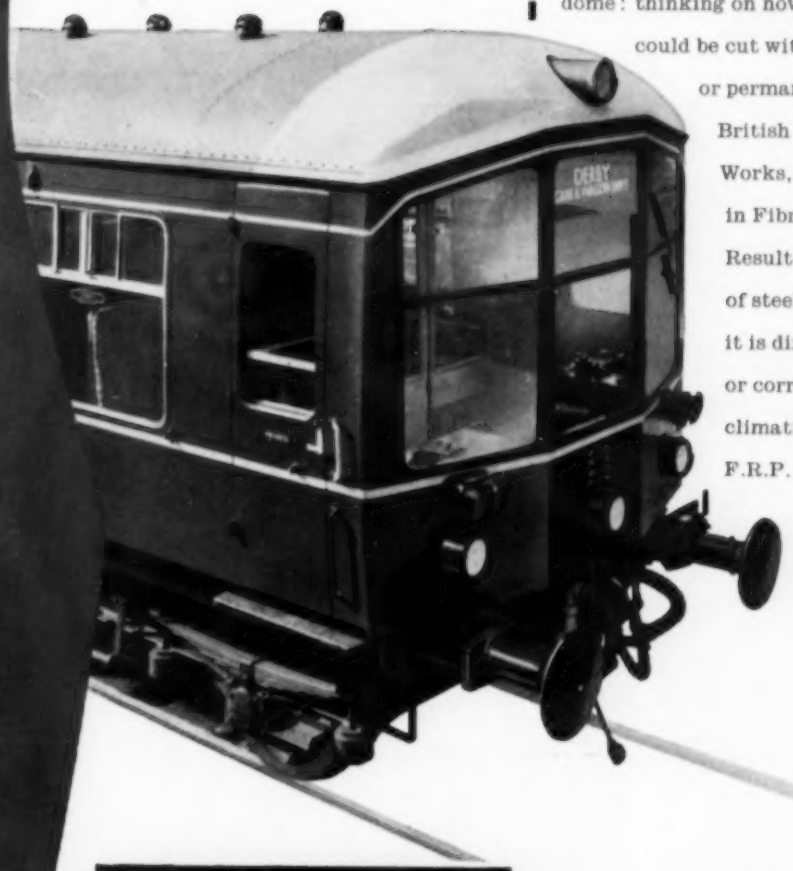
Accommodation can be varied from two to eight seats and, with seats removed, cargo shackles or two stretchers can be installed in a few seconds. Doors fold down and outward and the centre post is removable to make cargo loading an easy task.

Already two Mk IIs are operating for foreign airlines, one in the Dominican Republic (for Compania Dominican de Aviacon) and another, just delivered, with Societe Aerienne de Transports Guyana-Antilles (SATGA) Airlines. This latter is based at Cayenne, French Guiana, and serves Martinique, Guadeloupe and other small French island possessions in the Lesser Antilles group that have previously been served by more expensive amphibian-type aircraft. It is also flying into a 300ft strip, deep in the interior of French Guiana, to supply a small mining unit with supplies and machinery. The former one-week journey by boat, horse and foot to this remote mine location is now a matter of a 20-minute flight.

Performance figures of the Mk II Husky include: cruising speed 121 m.p.h. at 4,016 lb gross weight; empty weight 2,045 lb; fuel capacity variable, permitting cruising range of 400-700 miles; sea-level take-off distance 125ft (empty) and 255ft (at 2,650 lb); landing distance 75ft. Overall dimensions are the same as the original L-13A aircraft (span 40ft 6in; length 31ft 9in).

The Husky Mk II version of the Caribbean Traders' conversion of the L-13A is powered by a Lycoming R-680-13 of 300 h.p., in place of the original Franklin of 245 h.p. The eight seat installation illustrated below (right) is that of SATGA Airlines.

Moulding the future . . .



Diesel loco dons thinking cap.

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SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

With a Gannet wing-fold as background, the High Commissioner for Australia, Sir Thomas White, K.B.E., D.F.C., and Lt.-Cdr. G. Jude, R.A.N., discussed the formation of the first R.A.N. jet squadrons at Culdrose recently.

The Duke at St. Athan

ON October 14th H.R.H. the Duke of Edinburgh is to visit Royal Air Force Station St. Athan, South Wales.

A Standard for No. 100 Sqn.

DURING the latter half of next month a Squadron Standard is to be presented to No. 100 Sqn., now based at Wittering, near Peterborough, and commanded by S/L. C. P. H. Hunkler. Former members of the squadron interested in attending the ceremony are invited to get in touch with the squadron adjutant at the above address.

"New World" Progress

BETWEEN August 16th and 19th the Canberras of No. 139 (Jamaica) Sqn., engaged in Operation New World, visited British Guiana and Trinidad. The flying display given near Georgetown, capital of British Guiana, is reported to have drawn the largest crowd ever assembled in the colony. All shops and schools were closed for the occasion, and large crowds also assembled in a number of outlying towns over which the Canberras later flew.

On the way to British Guiana, one of the escorting Hastings received a severe jolting from turbulence, and repairs to the wing skin outboard of the engines had to be made as a result. Apart from turbulence, the main hazard at this time of year is the local brand of hawk, known as the jim crow. A Canberra struck one a glancing blow with its nose and the bird appeared to disintegrate in the engine intake. Another Canberra, flown by S/L. Ashworth, collected a swarm of small birds while flying through the smoke hanging over a sugar factory.

On August 18th the force moved to Trinidad in preparation for the third major demonstration of the tour. Plans were slightly altered here, so that by holding the demonstration over a park in Port of Spain, the capital, most of the 120,000 inhabitants were able to see it. A passenger during one of the flights was Rex Potter, a Trinidadian who is a candidate for a R.A.F. cadetship.

Service Conditions Report

THE Air Council is now studying a report submitted by a team of senior officers and scientists after a year of experiments at R.A.F. Benson. Activities, both on and off duty, were closely observed, and time-and-motion studies made in order to analyse methods of work with a view to improving them. Airmen were also asked to give honest opinions on conditions of service. Among suggestions which were

Probably the first air-to-air picture ever taken of the traditional bomb-burst break from formation aerobatics, the view on the left shows the team of Hunter F.1s of No. 54 Sqn., Odiham, performing the manoeuvre vertically downwards out of a loop in box formation. They are giving performances during the public days at the Farnborough Show. (Right) Brand-new Venom F.B.4s of No. 6 Squadron break from echelon over their present base at Habbaniyah. The Mk4 Venom, with powered ailerons, is also going into service with squadrons in Germany.

Official Canadian interest in the Hunting Percival Jet Provost was demonstrated recently when a R.C.A.F. evaluation team came to Luton to examine and fly the aircraft. Seen here (left to right) are F/L. W. Lehman, S/L. F. Watson, F/L. R. Cardin (engineer officer) and F/L. R. Litt.

SERVICE AVIATION . . .

made was one for a five-day week and higher pay, with more rapid promotion for skilled tradesmen. Others suggested smarter uniforms. Plastic raincoats, to replace the standard ground-sheet cape, were tried out; but grip-bags substituted for kit bags were rejected because they did not hold enough.

The main object of the experiments was to try to make the Service more attractive to volunteers, but the report is still under consideration and it is not yet known which of the suggestions will be adopted.

R.C.A.F. Arrester Gear

A NYLON-and-anchor-chain arrester gear is being installed at Uplands Airport, Ottawa. The chain weighs 100,000 lb and will stop a CF-100 in 1,000ft. This is the first installation of the kind in Canada, and the R.C.A.F. made extensive tests and inspections of U.S.A.F. installations in the U.S.A. before adopting it.

U.S. Navy Tests Mirror Aid

A MIRROR landing aid is being tested by the U.S. Navy aboard the carrier *Bennington* in the Atlantic. The sight, bought from Britain for £10,000, is mounted on the port side of the ship's angled deck. This is the third British device to be tested and probably to be adopted by the U.S. Navy. The other two are the angled deck and the steam catapult.

Thanksgiving Service at the Abbey

THE Battle of Britain Service of Thanksgiving for the victory won in 1940 will be held in Westminster Abbey at 3 p.m. on September 18th. The Queen will be represented by Air Chief Marshal Sir John W. Baker. Contingents of all units directly engaged in the battle will be on parade and the Chief of the Air Staff will lay a wreath on the R.A.F. memorial on Victoria Embankment. The Queen's Colour for the R.A.F. and the Ensign of Fighter Command will be paraded. The address will be given by Dr. Maurice Harland, Bishop of Lincoln, who was himself a R.F.C. pilot during World War 1.

Lone Ranger Canberras

INDIVIDUAL aircraft from No. 69 Sqn., based at Laarbruch, Germany, are going out to bases in Malta and North Africa for periods of 48 hours to carry out a series of photographic sorties in the clearer weather available in those areas. The two-man crews operate quite alone, doing their own first-line servicing and loading and unloading their own cameras.

One of the squadron's Canberra P.R.3s bears the inscription "Winner of the United Kingdom-to-New Zealand Air Race, 1953: 23 hours 51 minutes."

Emergency Ration Mk 5

ELABORATE tests are now being carried out on a new emergency ration pack, designated Mk 5 and designed for use in both tropical and arctic regions. Sample packs are being stored for periods of years in R.A.F. bases all over the world, and items from them are being exposed, in various wrapped and unwrapped conditions, to all types of climate. Large numbers of people have eaten the rations in various circumstances and found them satisfactory.

Packed in two different boxes, the Mk 5 contains oatmeal; milk chocolate; soup cubes; meat; glucose sweets; wheatmeal biscuits; processed cheese; soluble tea, sugar and milk sachets; sugar cubes; canned margarine; book matches, antimalarial and water-purifying tablets; salt tablets; and various other items, including a blue spoon designed to be clearly visible in snow.

R.A.F. Regiment Clears Mines

TWENTY-NINE members of No. 2 Field Sqn., R.A.F. Regt., Cyprus, are now engaged in clearing 200,000 sq yd of desert, round El Adem, of mines laid by Italian, German and British forces during the war. The heat of the sun and shifting sand still cause occasional explosions in the area. Only here has the mass of equipment abandoned after the desert battles not been stripped or removed by the Arabs. Almost every known type of land mine was laid, and the work of clearance will take several months.

Reunions

ON September 15th a Battle of Britain reunion and buffet supper will be held in the officers' mess at R.A.F. Biggin Hill, Kent. Tickets (£1 10s) from the Secretary, Battle of Britain Reunion Committee, Officers' Mess, R.A.F. Biggin Hill.

The tenth and final reunion dinner of No. 3 S. of G.R. (Squires Gate) will be held at the Casino, Blackpool, on October 1st. Details from A. C. M. Powell, 26 North Parade, St. Annes-on-Sea, Lancs.

This year's reunion of No. 612 Squadron is to be held in London on November 12th. Particulars obtainable from W. N. Parsons, Wildcroft, Farm Lane, East Horsley, Surrey.

The annual dinner of the R.A.F. medical and dental branches will be held at the Savoy Hotel, London, on November 18th. Tickets (£1 11s 6d) from the Hon. Secretary, R.A.F. Medical and Dental Services' Dinner Fund, Air Ministry (M.A.3), London, S.W.1.

No. 208 Sqn., R.A.F. (ex-No. 8 Naval) will hold a reunion dinner on October 8th at the Devereux, Devereux Court, Strand, London. Tickets (17s 6d) from R. W. Booker, 29 Great Road, Lancing, Sussex.

This year's M.R.E.S. Officers' Reunion will take the form of a dinner to be held on October 29th. Particulars from S/L. P. E. Laughton-Bramley, M.B.E., 18a, Cadogan Place, London, S.W.1.

Taken within the last few weeks, yet likely to induce acute nostalgia in many a senior R.A.F. officer, this photograph shows the Shuttleworth Trust Avro 504N lately rebuilt as a 504K by its original makers. It is being used in the film of the life of G/C. Douglas Bader, now being made at Kenley.

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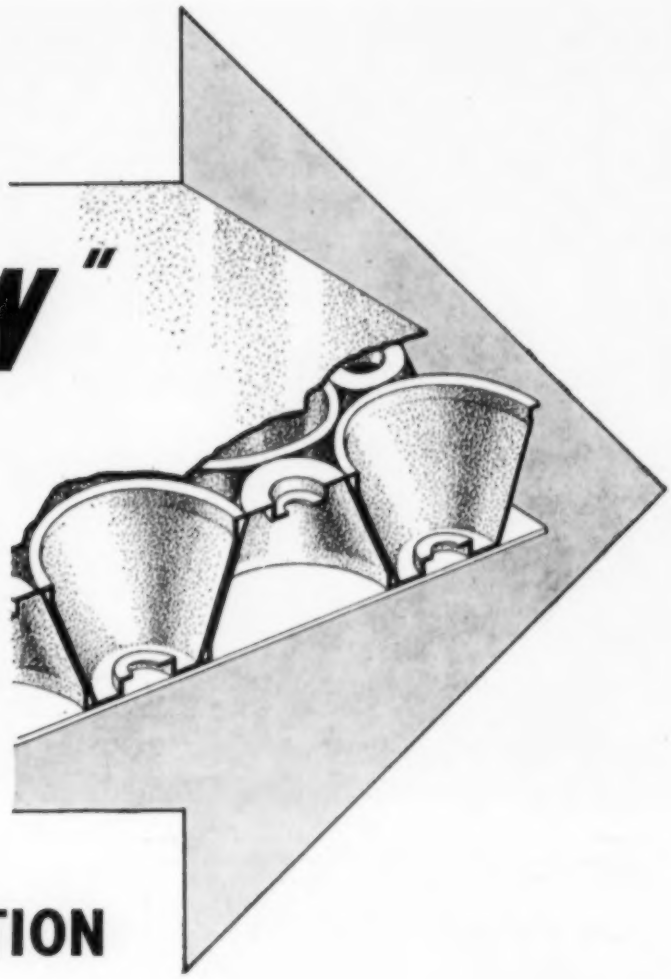

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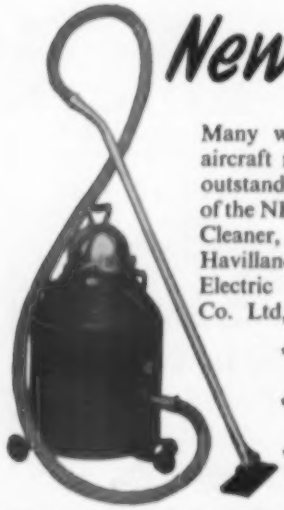

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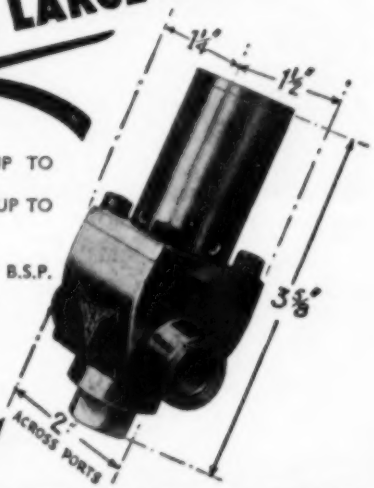

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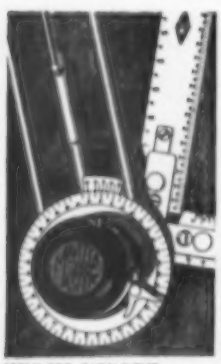

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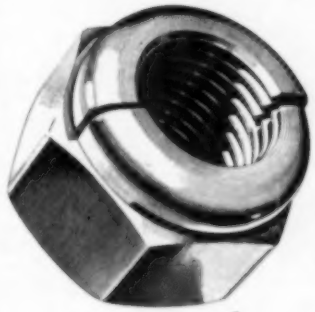

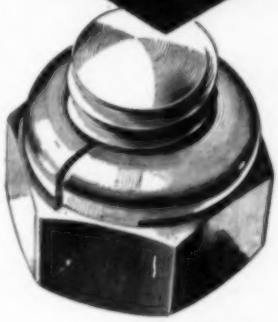

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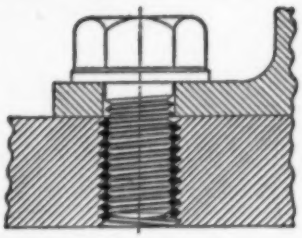

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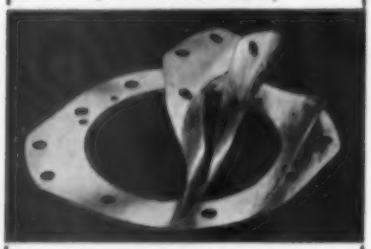

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MINISTRY OF SUPPLY requires Experimental Officers as Assistant Resident Technical Officers (Engines) at aircraft contractor's works in Coventry, Bristol and Derby. They will be responsible to the R.T.O. for technical matters concerning the design, testing and modification of aero engines. Quals.: Higher School Certificate (Science) or equivalent but possession of a degree or H.N.C. in Engineering may be an advantage. Workshop and drawing office experience required and an engineering apprenticeship desirable. Salary within E.O. range (Min. age 26) £745—£920 (Derby), £775—£940 (Coventry and Bristol). Women's salary subject to equal pay scheme. Application forms from M.L.N.S., Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting C666/5A. [4196

MANCHESTER CORPORATION Airports Department. Applications are invited from suitably qualified persons for the post of Airport Foreman, Manchester Airport, at a basic salary in accordance with Miscellaneous Grade IV of the National Scheme of Service Conditions—£465 to £545 per annum. (Average earnings approx. £650 to £760 per annum). The duties will include supervision of portering, aircraft marshalling, freight loading, etc. Further details, together with application form, are obtainable from the Airport Director, Manchester Airport, Wythenshawe, Manchester, 22, on receipt of a stamped addressed envelope. The forms should be returned to the same address by the 26th September, 1955. Canvassing is prohibited. Previous applicants need not apply. [4195

PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:

FROM Hunting-Clan Air Transport, Ltd., of 72, Wigmore Street, London, W.1, for the following Inclusive Tour Services to be operated with Viking aircraft for the carriage of passengers in conjunction with Wings Limited:

APPLICATION No. 581. For a service between London Airport and Geneva at a frequency of two return flights during the period from 19th May to 8th September, 1956, inclusive, to be operated on one Saturday every four weeks.

APPLICATION No. 582. For a service between London Airport and Barcelona at a frequency of nine return flights during the period from 3rd June to 23rd September, 1956, inclusive, to be operated on alternate Sundays.

APPLICATION No. 583. For a service between London Airport and Nice at a frequency of 11 return flights during the period from 13th May to 30th September, 1956, inclusive, to be operated on alternate Sundays.

APPLICATION No. 584. For a service between London Airport and Munich at a frequency of 10 return flights during the period from 26th May to 29th September, 1956, inclusive, to be operated on alternate Saturdays.

APPLICATION No. 585. For a service between London Airport and Basle at a frequency of five return flights during the period from 2nd June to 22nd September, 1956, inclusive, to be operated on one Saturday every four weeks.

APPLICATION No. 586. For a service between London Airport and Palma at a frequency of 10 return flights during the period from 25th May to 29th September, 1956, inclusive, to be operated on alternate Fridays.

APPLICATION No. 587. For a service between London Airport and Pisa at a frequency of nine return flights during the period from 2nd June to 22nd September, 1956, inclusive, to be operated on alternate Saturdays.

FROM British European Airways Corporation of Kevline House, Ruislip, Middlesex:

APPLICATION No. 258/1. For an amendment to the terms of approval of the Normal Scheduled Service which the Corporation are approved to operate between London and Malta via Nice and/or Naples at a frequency of two services weekly for the period up to 23rd March, 1961, so as to increase their frequency up to eight services weekly.

APPLICATION No. 259/1. For an amendment to the terms of approval of the Normal Scheduled Service which the Corporation are approved to operate between London—Dusseldorf and/or Munich—Athens—Istanbul (optional) at a frequency of three services weekly for the period up to 23rd March, 1961, so as to increase their frequency up to seven services weekly.

FROM Air Kruise (Kent), Ltd. of 1, Great Cumberland Place, London, W.1, for the following seasonal Inclusive Tour Services to be operated with

Continued in column 2, page 79)

H. M. HOBSON LTD.

have

VACANCIES

in their

DESIGN DEPARTMENT

as under:

DESIGNERS

Capable of initiating and supervising the design of fuel system equipment for gas-turbines, ramjets, rocket motors, and flying control equipment for advanced types of aircraft and guided missiles.

In addition, vacancies exist for:

DETAIL DRAUGHTSMEN,
MODIFICATION DRAUGHTSMEN,
TECHNICAL ILLUSTRATORS,
STRESSMEN,
TRACERS.

These posts carry good salaries and offer outstanding prospects of advancement.

Excellent working conditions in an attractive environment.

Five-day week. Restaurant.

Sports and Social facilities.

Write stating age and full particulars of experience to:

H. M. HOBSON LTD.,
FORDHOUSES,
WOLVERHAMPTON, STAFFS.

GLOSTER AIRCRAFT CO. LTD.

GLOUCESTER

HAVE VACANCIES ON SUPER-PRIORITY
DESIGN AND DEVELOPMENT PROJECTS

FOR

AIRCRAFT DESIGN DRAUGHTSMEN

(SENIOR & JUNIOR)

Consideration will also be given to Draughtsmen with Mechanical, Structural or Electrical experience.

Also

STRESSMEN

(SENIOR & INTERMEDIATE)

for both strength and flutter calculations.

The conditions of employment are good with progressive salary, good sports and welfare facilities, pension scheme, etc.

APPLICATIONS STATING AGE, PREVIOUS EXPERIENCE AND EMPLOYERS SHOULD BE ADDRESSED TO THE

CHIEF DESIGNER

D. NAPIER & SON, LTD.

Flight Development Establishment,

LUTON AIRPORT

Vacancies exist on the Technical Staff and in the Drawing Offices for work on a variety of projects dealing with the flight testing of new engines and installations.

Vacancies also exist in the section which is being expanded to deal with the Napier 'Spraymat' system of de-icing.

These posts offer good opportunities to young men recently qualified who seek to establish a career in aviation.

For Senior posts a degree or H.N.C. in engineering or applied science is required, preferably with an aircraft background.

For Junior posts O.N.C. with engineering training especially in the aircraft field is desirable. Service experience allied to technical ability in suitable subjects will be fully considered.

Apply with full details of past experience and training to

Dept. C.P.S.
336/7, Strand, W.C.2
quoting Ref. 1368

Are you a capable

PLANNING ENGINEER

Looking for a well paid progressive position?

If so

JOSEPH LUCAS LTD.

Burnley

Manufacturers of Aircraft and Motor Equipment

would like to offer for your consideration a few important vacant posts on Gas Turbine development work. Applicants should be fully skilled engineers possessing the Ordinary National Certificate or equivalent. A generous pension scheme is in operation. Pleasant working conditions. Full restaurant service.

Apply to
The Personnel Manager,
Hargher Clough Works.

VACANCIES

GOODYEAR AVIATION DIVISION

Wallasey.

Engineers required for Senior and Junior Posts, Design, Project, Draughting, Test and Stress Analysis. Expanding programme of Aircraft and Industrial Wheel and Brakes. Hydraulic and Electro Mechanical mechanisms. Attractive positions with an expanding organization. Pension Scheme.

Written application to PERSONNEL MANAGER, Goodyear Tyre & Rubber Co. (G.B.), Ltd., Wallasey.

PUBLIC ANNOUNCEMENTS

(*Continued from column 2, page 77*)

Dakota aircraft during the season from April to October inclusive, each year for a period of seven years, commencing April, 1956, for the carriage of passengers in conjunction with Sheffield United Tours:

APPLICATION No. 588. For a service between Manchester (Ringway) and Ostend at a frequency of one service weekly to be operated on Mondays.

APPLICATION No. 589. For a service between Manchester (Ringway) and Geneva at a frequency of one service weekly to be operated on Saturdays.

APPLICATION No. 590. For a service between Manchester (Ringway) and Luxembourg at a frequency of one service weekly to be operated on Saturdays.

APPLICATION No. 226/2. From Air Kruise (Kent), Ltd., of 1 Great Cumberland Place, London, W.1. For an amendment to the terms of approval of the seasonal Normal Scheduled Service which the Company are approved to operate with Dakota, D.H.89, D.H. Dove and D.H. Heron aircraft between Lydd and Calais at a frequency of up to three return flights per day during the season from April to September inclusive each year for the period up to 30th September, 1960, so as to operate the service all-the-year-round.

APPLICATION No. 382/1 from Yeadon Aviation, Ltd., of Yeadon Airfield, near Leeds, for permission to use Dakota aircraft throughout the period of approval, in addition to the aircraft types already authorised, on the seasonal U.K. Internal Service between Leeds (Yeadon) and Isle of Man (Ronaldsway), which the Company has been approved by the Minister of Transport and Civil Aviation to operate during the season from April to October inclusive each year, for the period up to 1st October, 1961, at a frequency of up to 14 return flights weekly.

FROM Dan-Air Services, Ltd., of Bilbao House, 36-38 New Broad Street, London, E.C.2, for the following Inclusive Tour Services to be operated with Dakota aircraft, for the carriage of passengers and supplementary freight, in conjunction with Arrowsmith Holidays, Ltd., at a frequency of from two to four return flights weekly for each service, operated on Fridays, Saturdays, Sundays, or Mondays, during the season from May to September inclusive each year, for a period of seven years, from 1st May, 1956:

APPLICATION No. 591 for a service between London (Blackbushe) and Basle.

APPLICATION No. 592 for a service between London (Blackbushe) and Turin.

APPLICATION No. 593 for a service between London (Blackbushe) and Biarritz.

APPLICATION No. 594 for a service between London (Blackbushe) and Milan.

APPLICATION No. 595 for a service between London (Blackbushe) and Lyons.

APPLICATION No. 596 for a service between London (Blackbushe) and Nice.

APPLICATION No. 597 for a service between London (Blackbushe) and Paris (Le Bourget).

APPLICATION No. 598 for a service between London (Blackbushe) and Ostend.

APPLICATION No. 599 for a service between London (Blackbushe) and Perpignan.

APPLICATION No. 600 for a service between London (Blackbushe) and Toulouse.

APPLICATION No. 601 for a service between London (Blackbushe) and Palma.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3, Dean's Yard, London, S.W.1, from whom further details of the application may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections.

THE Air Transport Advisory Council also give notice that the following applications have now been withdrawn:

APPLICATIONS Nos. 520, 521, 524 and 525 from Dan-Air Services, Ltd., of Bilbao House, 36-38, New Broad Street, London, E.C.2, for Inclusive Tour Services in conjunction with Mercury Travel, Ltd., between London (Blackbushe) and Innsbruck, Ajaccio, Perpignan and Barcelona, respectively. These applications were advertised in "The Times," "The Aeroplane," and "Flight" on 15th July, 1955. [4204

TUITION

CIVIL Pilot/Navigator Licences.

AVIGATION, LTD., provides full-time or intermittent instruction and postal tuition, or a combination of any of these methods to suit individual requirements for the above licences. Instruction can be provided for A.R.B. General, certain specific types, and A.R.B. Performance schedule examinations. Link-training Dept. (City 1162) situated centrally in London. Full briefing for I/R 25/- hr. Block rate (min. 10 hrs.) 22/6 hr.

For full details apply to: The Principal,
AVIGATION, LIMITED,
30 Central Chambers, Ealing B'way, London, W.5.
Tel.: EALing 8949 [0248

THE ENGLISH ELECTRIC COMPANY LIMITED

AIRCRAFT DIVISION

Due to the further expansion of the Division, there are vacancies in the Departments shown below for Designers and Engineers interested in working on problems associated with high speed aircraft.

AERODYNAMICS

Aerodynamicists are required to work on a variety of problems including elasticity, gust studies and auto-control analysis. The Aerodynamics Department has a six degree of freedom analogue computor to assist in this and similar work, and also makes extensive use of high speed digital computors.

AERO MECHANICAL ENGINEERING

Qualified mechanical engineers are required for work on a wide range of interesting and challenging problems arising from the ever increasing complexity and severity of the demands of aircraft operating at high supersonic speeds. The work involves the application of all branches of basic mechanical engineering knowledge to the solution of problems resulting from kinetic heating, etc., and to the practical design of fuel, air, refrigeration and other systems for high speed aircraft.

DRAWING OFFICE

Design Engineers and Draughtsmen are required for all classes of work at both Warton and the London D.O. at Acton. The Division's experience in high speed aircraft is unique and applicants are assured of interesting work with one of the most progressive design teams in the country.

FLIGHT TEST

The expansion of this department requires further Engineers to work on an interesting and varied programme of flight testing of very advanced supersonic aircraft, for which a large pre-production order has been placed.

STRESS

Senior Stress Engineers and Stress Engineers are required for work on the structural analysis of modern high speed aircraft. There are also vacancies for engineers who are interested in the application of new stressing methods (involving the use of digital computors) and for work on thermal stress analysis. Vacancies exist for these posts at Warton and London.

WIND TUNNEL

Trained engineers are required for this department which has been engaged in transonic research since 1950. The Division was the first industrial concern in this country to have its own transonic tunnel, and the present facilities of the Department include two supersonic tunnels, a low speed tunnel and a water tunnel. Applicants should have a degree in Engineering or Physics, or H.N.C. and previous experience of Wind Tunnel work is desirable, but not essential.

All these posts are permanent and pensionable and assistance in removal expenses to Warton (near Lytham St. Annes) will be given in certain cases. Applicants can be interviewed in London if desired.

Apply, in writing, to Dept. C.P.S., 336/7, Strand, W.C.2. quoting Ref. No. SA. 27H.

DESIGNERS • DRAUGHTSMEN

THE DE HAVILLAND ENGINE COMPANY

has now opened a

LONDON DESIGN OFFICE

at UPPER JAMES STREET, PICCADILLY, W.1

where teams are actively engaged in the design of some of

THE WORLD'S MOST ADVANCED AIRCRAFT PROPULSION UNITS

We need men of initiative with the ability to play their part in advancing these interesting and important projects.

Lack of aero engine experience need not deter you from getting in touch with us. If you have a good automobile, marine or general mechanical engineering background you can still make an important contribution.

These posts are permanent, commanding good salaries with excellent prospects of advancement. Pension and superannuation schemes in operation. Luncheon vouchers.

If you would like further details of these attractive positions, we would be pleased to discuss them with you.

Write for an appointment to:—

THE CHIEF DRAUGHTSMAN,

THE DE HAVILLAND ENGINE COMPANY LIMITED,

2 UPPER JAMES STREET, PICCADILLY, W.1

TUITION

AIR SERVICE TRAINING

the only fully equipped private School of Aviation. Specialist staff, comprehensive equipment and full residential and recreational facilities within the School ensure the soundest training for an Aviation Career.

M.T.C.A. APPROVED

courses in primary, intermediate and advanced training for pilots, navigators, radio officers and maintenance engineers.

HELICOPTER COURSES

for private and professional licences. Details available from: The Commandant,

AIR SERVICE TRAINING, LTD.

Hamble, Southampton. Tel.: Hamble 3001/9. [0970

DERBY AERO CLUB, Burnaston Airport, Derby, the flying school for the Midlands. M.T.C.A.-approved 30-hour course for the P.P.L., also flying instructors' courses. Auster, Hawk, Gemini and Rapide aircraft available. Telephone: Etwall 323. [4126

ELSTREE FLYING CLUB, Elstree Aerodrome, Herts, the flying school for the South. M.T.C.A.-approved 30-hour course for the P.P.L., also instrument and night flying, twin conversions and instructors' courses. Catering and bar facilities. Telephone: Elstree 3070. [4127

FREE! Brochure giving details of courses in all branches aero eng. covering A.F.R.Ae.S., M.C.A. exams, etc. Also courses for all other branches of engineering.—Write: E.M.I. Institutes, Dept. F26, London, W.4. (Associated with H.M.V.) [0964

NIGHT Flying, instrument flying, commercial pilot licences. Approved M.T.C.A. private pilot's course.

EVERY facility at reasonable rates from

SOUTHEND - ON - SEA MUNICIPAL AIR CENTRE and FLYING SCHOOL, Municipal Airport, Southend-on-Sea, Rochford 65204. [0452

LONDON SCHOOL OF AIR NAVIGATION in conjunction with Airways Aero Associations, Ltd. OFFERS completely co-ordinated and integrated training for professional pilots/navigators.

M.T.C.A. approval for commercial pilots and instrument rating courses, also P.P.L. All ground and air subjects to U.K.'s application ICAO standards.

TRAINING focalised London.

FULL-TIME personal coaching Com./IR:Sen/Com:AL.TP:F/Nav. Pungent and effective.

HOME study tutorial (correspondence) excellent alternative: full coverage: modern presentation: attractive terms.

LINK, briefing, procedures, airways; R/T. Type rating, general, specific, per schedules.

SUCCESSES highest in country. Rehabilitation from services to civil.

33 OVINGTON Sq., London, S.W.3. KEN. 8221. Flying base: Croydon Airport. [0277

AERONAUTICAL. Comprehensive full-time technical and practical training for careers in all branches of aviation engineering. Diploma course leads to interesting executive appointments in civil aviation design and development, draughtsmanship, maintenance, etc. Extended courses to prepare for A.F.R.Ae.S. and A.M.I.Mech.E. examinations. Write for prospectus to Engineer in Charge, College of Aeronautical Engineering, Chelsea, London, S.W.3. Flaxman 0021. [0019

A.F.R.Ae.S., A.R.B.Certs., A.M.I.Mech.E., etc., on "no pass, no fee" terms; over 95 per cent successes. For details of exams and courses in all branches of aeronautical work, navigation, mechanical eng., write for 144-page handbook free.—B.I.E.T. (Dept. 702), 29 Wright's Lane, London, W.8. [0707

LEARN to fly for £26. Instructor's licences and instrument flying for £3/5/- per hour. Night flying £4/5/- per hour. Residence 5 gns. weekly. Approved M.C.A. private pilot's licence course. Specialized course for junior commercial pilot's licence. Wiltshire School of Flying, Ltd., Thruxton Aerodrome, nr. Andover, Hants. Tel. Weyhill 352. [0253

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

METHODS ENGINEERS

and

PLANNING ENGINEERS

Urgently required
for new and interesting work
involving use of
the latest types of machine tools
in one of the
most technically advanced factories
in the South.
A Country atmosphere
only 4 miles from town.
Convenient Transport—Special Prices.
Excellent Canteen and Sports Facilities.
Apply Personnel Department,
VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED,
SOUTH MARSTON WORKS,
NR. SWINDON, WILTS. [4191

The London Design Office

of

BLACKBURN & GENERAL AIRCRAFT, LTD.

HAVE vacancies for the following staff for work on a very interesting new design:

ASSISTANT CHIEF STRESSMAN
SENIOR STRESSMEN
WEIGHT CONTROL ENGINEER

THESE are responsible positions with excellent salaries and prospects.

PLEASE send full particulars of experience, etc., to: The Manager, Blackburn and General Aircraft, Ltd., 63, Old Brompton Road, London, S.W.7. [4189

(m) TECHNICAL LIAISON ENGINEERS

(Airframe and Electrical)

IN the Civil Aircraft Service Department. Applicants should be well educated, including an apprenticeship or similar training, and have had some experience of aircraft design.

APPLICATIONS, quoting date and prefix letter of advertisement, to: Employment Manager, Vickers-Armstrongs (Aircraft), Limited, Weybridge Works, Weybridge, Surrey. [4199

(n) WIND TUNNEL TECHNICAL ASSISTANTS

VACANCIES exist for applicants who should possess a degree or Higher National Certificate in Aeronautics or Mechanical Engineering, or equivalent qualifications. Some senior vacancies exist for men with good experience in wind tunnel work.

APPLICATIONS, quoting date and prefix letter of advertisement, to: Employment Manager, Vickers-Armstrongs (Aircraft), Limited, Weybridge Works, Weybridge, Surrey. [4200

INTEGRAL LIMITED, Birmingham Way, Wolverhampton.

INVITE applications for vacancies on the Design and Development Staff for Technicians and Draughtsmen of both Senior and Junior grade, the work is on interesting new projects concerning aircraft hydraulic mechanisms. Experience in aircraft component design, testing and good technical qualifications are desirable. Will applicants please apply to the Chief Engineer, stating age, qualifications, experience and salary required. [4117

STAFF pilot required, preferably with Hornet or Mosquito and some jet experience. Apply: Airwork, Hurn Airport. [4190

AIRCRAFT DESIGN DRAUGHTSMEN

An expanding aircraft company near London has vacancies for a number of Project Design Draughtsmen. Applicants, who must have had several years experience in an Aircraft Design Office of repute, are required for original design work on projects of an advanced nature. The positions offer excellent prospects of advancement to suitably qualified men with commencing salaries up to £1,000 p.a.

Box A.C.10156 Samson Clark and Co. Ltd., 57-61 Mortimer Street, W.1

TECHNICAL ASSISTANT

An interesting opportunity occurs for a Technical Assistant in the Analogue Computing Section.

Applicants must possess H.N.C. (Elect.) or equivalent with basic knowledge of electronics and be interested in the solution of problems associated with aircraft engineering.

This post is permanent in N.W. London area and carries generous salary with attractive working conditions.

Apply in confidence:
Box AC10805,
Samson Clark & Co. Ltd.,
57/61 Mortimer Street, London W.1.

Sir W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD.

ARMAMENTS DIVISION

ELECTRICAL AND ELECTRONIC ENGINEERS FOR WORK ON GUIDED MISSILES

1. **Electronic and Electrical Engineers**
   Some graduates with one or two years' experience are required to form development and design teams to undertake work covering a wide field in communication systems, electronic instrumentation and the overall electrical design of guided missiles. The essential qualifications required are an engineering degree or its equivalent and preferably some practical experience.
2. **Technical Assistants**
   A number of vacancies exist for men with H.N.C. or equivalent and radio development or maintenance or similar experience to undertake interesting work of a practical nature. Opportunity is given to technical assistants to move on to the more advanced work in due course.
3. **Draughtsmen**
   A number of draughtsmen are required for the following Electronic Group Design branches:—
   i. Missile Electrical Systems.
   ii. Test Gear.
   iii. Communications, e.g., Telemetry Systems.
   iv. Precision (Instrument type) Mechanisms.

NOTE:

The Armstrong Whitworth Electronics Group covers an extremely wide field in Communications, Electronic Instrumentation and Electronic Engineering and offers unique opportunities to the right type of man, particularly in view of continual expansion of staff and facilities.
In all cases Service or Government Research experience in either Radar or Radio or apprentice training is an advantage.
Assistance to housing suitable applicants for the more senior positions will be given if required.
An attractive superannuation scheme is operated by the firm and applicants for all the above positions are eligible.

APPLY TO THE PERSONNEL MANAGER, ARMAMENTS DIVISION
SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD.
BAGINTON, NR. COVENTRY

SITUATIONS VACANT

A. V. ROE & COMPANY, LIMITED, have the following vacancy in their Technical School, situated at Woodford Aerodrome, Chesnire.

AN Instructor/Electrical is required for lecturing on aircraft electrics. Applicants should have served an apprenticeship as an electrician and have a knowledge of A.C. as well as D.C. Preference will be given to those having aircraft experience (including A.C. instruments) and also to those who have done some instructing previously.

APPLICATIONS giving full details of age, experience and qualifications, also salary required, should be addressed to the Labour Manager, A. V. Roe & Co., Limited, Greengate, Middleton, Manchester. [4172

LICENSED Aircraft Engineer required for Tanganyika, salary £100 per month, free housing; must have A and C Licences Dove and Dakota. Box No. 6171. [4192

SENIOR and Junior Aircraft Draughtsmen and Stressmen required for new department of well established firm situated in pleasant surroundings. Write, stating age, experience and salary required, to DESIGN Office Superintendent, Western Airways, Ltd., Exeter Airport. [4171

TEST and Laboratory Engineers required for gyro and electro mechanical instruments. Apply stating age, experience and salary required to S. G. Brown, Ltd., Shakespeare Street, Watford, Herts. [0147

WELDER, Aircraft, experienced and approved (mainly steel) permanent position, interesting work. Full details to Edgar Percival Aircraft, Ltd., Stapleford Tawney Aerodrome, near Abridge, Essex. [4176

DRAWING Office clerk, male, required for aircraft factory in Hillington. Familiar with filing and recording procedure. Apply in writing to: King Aircraft Corporation, Fifth Street, Montrose Avenue, Hillington, Glasgow, S.W.2. [4174

IMMEDIATE vacancies available for Flight Radio Operators with M.T.C.A. licences. Please apply stating experience and qualifications to Operations Superintendent, Eagle Aviation, Blackbushe Airport, Camberley. [4205

INSPECTORS—Electrical and Instrument required, it is preferable but not essential that X Licences are held. Write in the first instance stating previous experience and qualifications in Civil or Service capacity to:

THE Chief Inspector, Messrs. Aviation Traders (Engineering) Ltd., Stansted Airport, Stansted, Essex. [4203

REPRESENTATIVE, preferably with connections, required by manufacturers of Aircraft wiring equipment and switches to call on Aircraft Constructors, etc., also on large users of fluorescent fittings. Exceptional opportunity to right man. Write in confidence to Box 6257. [4202

THE AIR REGISTRATION BOARD require a Computor having General Certificate of Education with advanced level in Mathematics. Salary according to age and experience. Apply in writing to The Secretary, Air Registration Board, Brettenham House, Strand, London, W.C.2. [4179

COMMERCIAL PILOT wanted with Dove endorsement for two year operation with civil engineering contractor in Persia. Accommodation and messing provided. Salary £1,500 p.a. Apply W. S. Shackleton, Ltd., 175 Piccadilly, London, W.1. Telephone HYDe Park 2448. [4210

DEVELOPMENT engineers and technicians required in research department of a well-known firm of precision engineers, particularly for work in connection with servo systems, small precision motors, and gyroscopic instruments. Apply stating age, experience and salary required to S. G. Brown, Ltd., Shakespeare Street, Watford, Herts. [0146

ELECTRICAL Project Engineer required, experienced in the development and production of P.M.P. motors and similar Special Purpose Aircraft Equipment. Also Engineers with experience of hydraulic equipment. Salaries up to £1,000 per annum according to qualifications. Modern factory, N. Berks. Superannuation scheme. Write giving details of experience and qualifications to Box 5901. [0454

ARMSTRONG SIDDELEY MOTORS have an immediate vacancy for an Instructor in their Gas Turbine School. Candidates must be trained Instructors (preferably ex-service) who have passed one of the Instructional Technique Courses, and should have done some instruction on engines, preferably with some jet engine experience. Apply in detail to Reference I/1, Personnel Manager, Armstrong Siddeley Motors, Coventry. [4183

WANTED, DRAUGHTSMEN to design in aluminium for sales development. Must possess Higher National Certificate in Mechanical Engineering. Location Banbury. Good working conditions and pleasant surroundings. Attractive starting salaries offered up to £800 p.a. with prospects of promotion from drawing board. Pension plan in operation. Send brief details of qualifications and experience to Northern Aluminium Co., Ltd., Bush House, Aldwych, London, W.C.2. [0348

SENIOR and Intermediate Design Draughtsmen with aircraft and mechanical engineering experience required. The work will interest men who can apply their design ability to the development of new equipment which has a steadily growing application. Pleasant working conditions. Pension and Insurance Scheme. Housing assistance for successful applicants. Within easy reach of Bournemouth. Special transport facilities. Apply in writing to Personnel Manager, Flight Refuelling Limited, Tarrant Rushton Airfield, Nr. Blandford, Dorset. [4209

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED

AT WEYBRIDGE, SURREY, AND AT HURN, NEAR BOURNEMOUTH, HANTS,

have vacancies for:

(j) **DESIGN DRAUGHTSMEN** (Senior, Intermediate and Junior) and

(k) **STRESSMEN** (Senior and Intermediate) for an interesting programme of work generally covering development and conversion of military and civil types and particularly development of the VISCOUNT and new CIVIL PROJECTS.

Applications are invited from STRESSMEN and DRAUGHTSMEN with experience in:

Structures.

Light mechanical and engineering.

Electrical and radio installation and equipment.

Pressure, ventilating and fuel installations.

Internal furnishing and equipment.

Previous aircraft experience is not essential; applicants will be judged on good engineering qualifications.

Applications.—Write, in the first instance, to:

The Chief Designer (A/DM), Vickers-Armstrongs (Aircraft) Limited, Weybridge Works, Weybridge, Surrey.

Quoting date and prefix letter of advertisement.

Facilities are provided for:

Superannuation — Canteen
Sports Club — General Welfare
Special Public Transport

Assistance can be given in obtaining lodging accommodation for individual applicants.

Holidays already arranged by applicants for this year are taken into account.

HUNTING PERCIVAL AIRCRAFT LTD., LUTON AIRPORT, BEDS.

require the following personnel for very interesting top priority work on long term Ministry of Supply contracts:—

1. **SENIOR AND JUNIOR TECHNICIANS** with experience in one or more of the following:—

   Stressing,
   Electronics,
   Instrumentation for experimental testing,
   Structural test work.

   Degree standard is desirable but not essential if applicant has suitable experience.

2. **SENIOR AND INTERMEDIATE DESIGN DRAUGHTSMEN** with experience in one or more of the following:—

   Light structural engineering,
   General mechanical engineering,
   Electrical installation and equipment.

   H.N.C. Standard is desirable but not essential if applicant has suitable experience.

Good salaries will be paid and will be assessed in accordance with qualifications and experience.

These are permanent positions with very bright promotion prospects. Good welfare facilities, including Pension Scheme.

Why not arrange to come and have a talk with us about these positions? It could prove beneficial to you.

Applications, giving full details of experience and qualifications, to

THE PERSONNEL MANAGER.

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LIMITED

have vacancies for

ONE ASSISTANT CHIEF AERODYNAMICIST

with at least four years experience of transonic and/or supersonic wind tunnels, and

SEVERAL AERODYNAMICISTS

with some transonic or supersonic wind tunnel experience. Equipment in use comprises a 2ft 10,000 h.p. continuous tunnel capable of a Mach number of 3, and a smaller intermittent tunnel.

ONE SENIOR MATHEMATICIAN

is also required to take charge of a large digital computer.
All these posts carry good salaries and excellent prospects. Housing assistance can be given to applicants for the Senior Posts.

Apply to:—

The Chief Aerodynamicist, Wind Tunnel Division,
Sir W. G. Armstrong Whitworth Aircraft Ltd.,
Baginton, Nr. Coventry

Required for

COMPANY AIRFIELD

in

BRITISH BORNEO

AIRCRAFT MAINTENANCE ENGINEER WITH A AND C LICENCES,

Approximately 26-34 years of age, single preferred but married man considered. The post is with an established maintenance organization for a fleet comprising Prince and Sealand aircraft to which Helicopters may be added in future. Makers' instruction courses would be arranged to assist successful candidate to obtain necessary licence extensions before departure overseas. Basic salary in line with experience plus local allowances, pension fund and all travelling expenses paid for interview in London.

Write, giving full particulars, to:

The Shell Petroleum Company Limited,

Staff Department (R),

16, Finsbury Circus, London, E.C.2.

JOSEPH LUCAS LTD.

Burnley

Manufacturers of Aircraft and Motor Equipment

offer a progressive position to fully trained Time Study Engineers. Applicants should have served an apprenticeship as skilled Machinists or as skilled Sheet Metal Workers. They should hold at least the Ordinary National Certificate. High salaries will be paid to the right men. A generous pension scheme is in operation and working conditions are exceptionally good. Full restaurant services are available.

Apply to

The Personnel Manager,

Hargher Clough Works,

Burnley.

MARSHALL

AIRPORT WORKS, CAMBRIDGE

have vacancies for

AIRFRAME FITTERS

AERO ELECTRICIANS

Long-term employment available on modern types of Service and Civilian Aircraft (including Passenger and Transport).

Some of these vacancies will have special appeal to highly skilled Tradesmen interested in experimental or T.I. work.

Excellent Hostel or lodging accommodation available and in certain circumstances subsistence allowances will be paid.

Address all applications to

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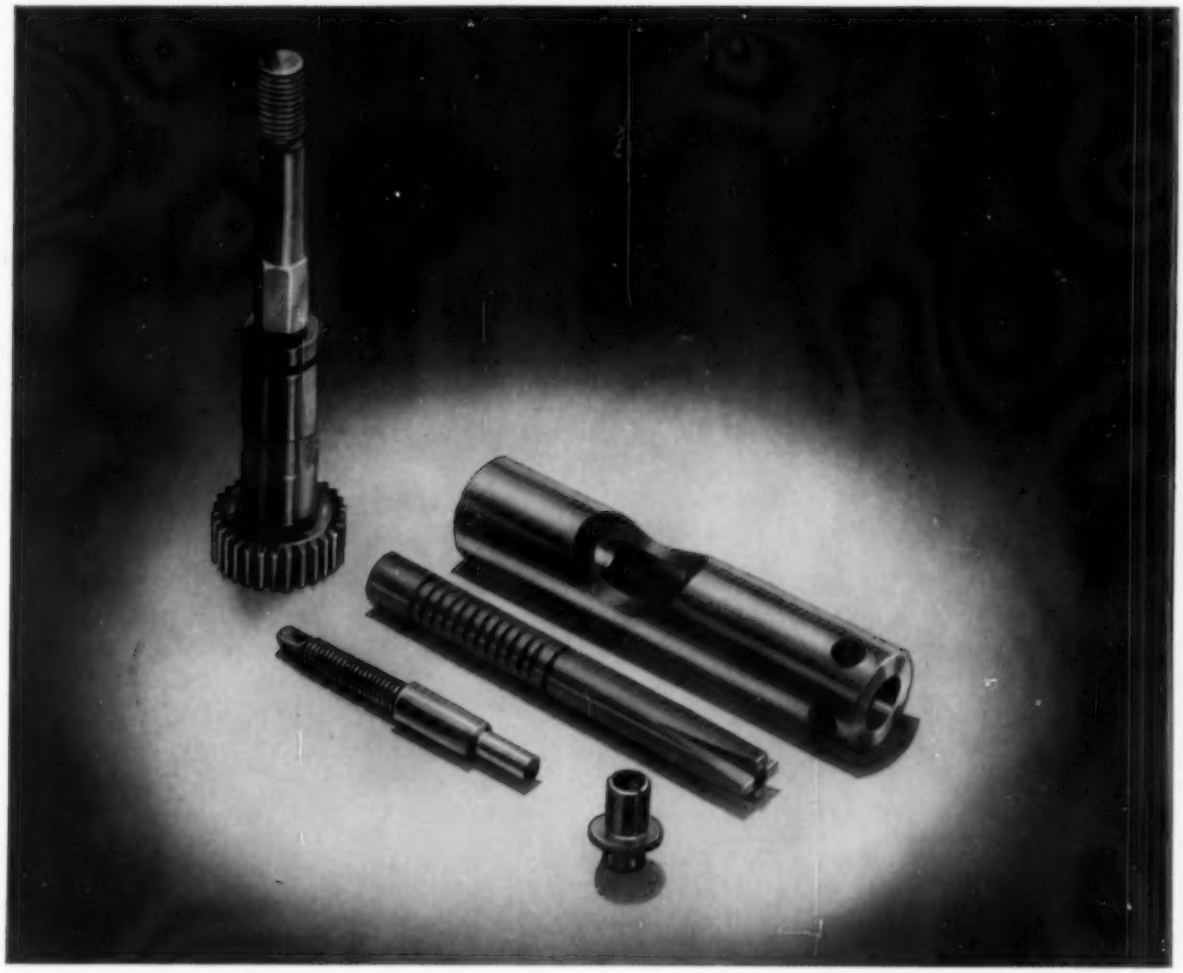

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